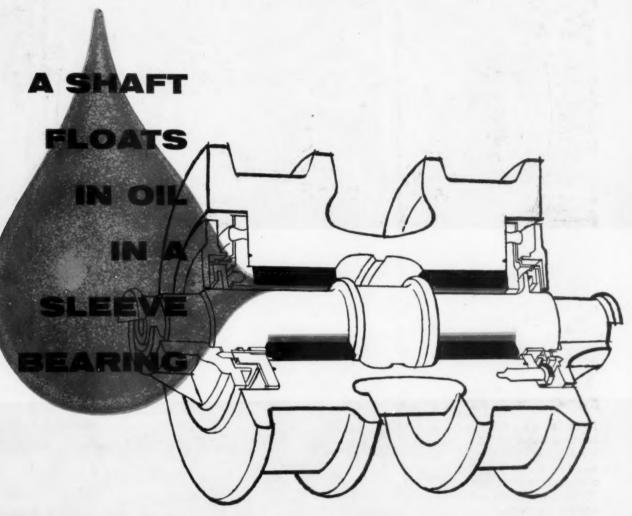
POWER OCTOBER 1959 TRANSMISSION DESIGN DEM MAINTENANCE





News and ideas for designers and plant engineers who use power drive equipment

FIFTEEN MINUTE SERVICING ON THE ROAD OR IN THE FIELD

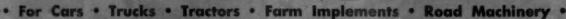
Manufacturers recommend that universal joints be removed, cleaned, lubricated and replaced at regular intervals. The down-time required can be reduced from hours to 15 minutes-by equipping your product with MECHANICS UNIVERSAL JOINTS. The bearing assembly can be lifted out, simply by removing the screw bolts. Because keys and keyways are ground to fit there is no

danger of destroying the original accurate alignment and balance. Let our engineers show you how this exclusive feature of MECHANICS UNIVERSAL JOINTS will give your product competitive advantages.

MECHANICS UNIVERSAL JOINT DIVISION Borg-Warner * 2038 Harrison Avenue, Rockford, Illinois

MECHANICS UNIVERSAL JOINTS

Roller Bearing BW



Aircraft
 Tanks
 Busses and Industrial Equipment

For more information circle No. 20 on Reader Service Card.

maurey positive drives

give you three mighty advantages

SMOOTH, SLIP-PROOF POWER TRANSMISSION

With belt teeth meshed in pulley grooves, Maurey Positive Drives are slip-proof as chain and gear drives. Maximum power moves to work smoothly, quietly, with uniform speed. There is no rise and fall of pitch line, no slippage, no creeping, no backlash. Here, in brief, is smooth, positive power transmission on heavy loads or the finest precision work.

2 WIDE RANGE OF SPEED AND HORSEPOWER IN COMPACT SIZE

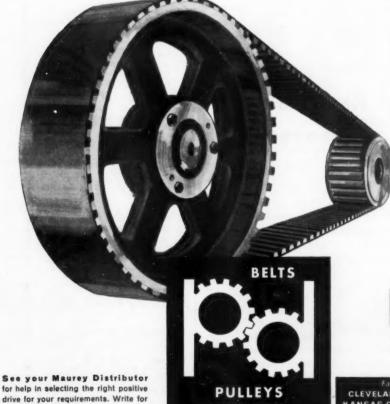
From fractional horsepower to 600 h.p., Maurey Positive Drives are proven drives. Their normal belt speeds range from 100 fpm to 10,000

fpm. Belts and pulleys combine maximum horsepower with minimum space. This inherent compactness is a vital advantage to the designer facing weight and space limitations.

3 LOW COST POWER TRANSMISSION

Since the Maurey Positive Drive does not rely on friction, high initial belt tension is not needed. That means minimum bearing load all the time, and low heat build-up while the drive runs. With no metal-to-metal contact, there is no need of lubricating systems. Adjustable motor bases and idlers are frequently eliminated. With no "extras" and practically no maintenance, here is true economy.





For more information circle No. 19 on Reader Service Card

catalog information.





Designed with high-hardness gearing for longer life. One-piece low speed end housing construction insures gear alignment and prevents oil leakage. Compact design. All three types available for foot-mounted or flange-mounted installation, and for horizontal or vertical application. Capacity is up to 250 hp.

NEW! Jones In-Line Helical Reducers



NEW! Jones Shaft-**Mounted Reducers**

High-hardness gearing gives compact design and extra service life. Positive sealing against oil leakage through double lip type seals. All gearing straddle-mounted between anti-friction bearings. Single and double reduction units to 40 hp. Six standard sizes. Flangemounted units available in three standard sizes.



Jones Herringbone Gear Reducers

Accepted throughout industry; balanced design, heavy-duty roller bearings, rugged cast iron housing for reliable service and low maintenance costs. The most comin industry.



Jones Worm Gear Reducers

Horizontal and vertical shaft types available with ratios to 80:1. Heavy-duty roller bearings throughout with high-test cast iron housings for positive gear alignment.



Jones Worm Helical Reducers

For vertical output shaft service; ratios from 25.63:1 to 357.5:1. Provide optimum combination of initial cost, efficiency, and low maintenance. Proven in hundreds of installations; redesigned to incorporate latest improvements in metallurgy and reducer design.



Jones Speed Reducers for every purpose

One of the most comprehensive speed reducer lines in industry! With new shaft-mounted reducers, in-line helical reducers, and gearmotors, Jones now offers a wide selection for all your power transmission needs. New technical literature gives you exactly the information you need for proper selection of units in accordance with latest A.G.M.A. ratings. Be sure to ask your Jones representative for copies, or write Hewitt-Robins, Stamford, Connecticut. Ask for Bulletin 10-22.



HEWITT-ROBINS

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...if your problem involves applying or connecting power to driven equipment...

...it pays to consult a company that specializes exclusively in correctly linking horsepower to driven equipment. Since 1918, Twin Disc specialists have designed and built Friction and Fluid Drives for just that purpose. Because of this specialization, Twin Disc can make unbiased recommendations regarding the proper type drive—friction or fluid—for almost any type heavy-duty industrial equipment—used in any type application.



Fluid Couplings — Small aluminum type, 7.4S to 10.6. Large stamped-steel type, 12.2 to 27. Ranges from ¾ to

850 hp for motors or internal combustion engines. Bulletin 144-D.

PO Air-Actuated Clutches — Specially designed for operation at higher speeds



with less inertia and greater efficiency, Model PO is offered in sizes from 8" to 42" (up to 276,000 lbs. ft. slippage capacity). Bulletin 304-A.



Friction Power
Take-Offs—
Triple-plate
14" to 21";
double-plate
11.5" to 24";

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DO, DOC, MTS, MTU Multiple Plate Clutches—DO, DOC oil-actuated for remote control without mechanical linkage. MTS, MTU (both oil and dry types) mechanically actuated. Single and duplex. Sizes 3" to 12"—.4 to 44 hp per 100 rpm. Bulletins 314 and 134-C.



Models CL, E, EH Clutches—Models E and EH in sizes 14" to 36", capacities 13.5 to 350 hp per 100 rpm. Model CL in sizes 5.5" to 11.5", 1.5 to 19.5 hp per 100 rpm. Bulletins 108-F and 120-D.

Fluid Power Take-Offs—Incorporate Fluid Coupling. For all types internal combustion engines. Models 14.5, 17.5 and 21. Bulletin 144-D.



HYDRO-SHEAVE®
Drives — Complete, ready-toinstall, fluid power
transmission pack-



age for both motors and engines. Protects both driving and driven equipment. Capacities from ³/₄ to 50 hp. Bulletin 145-C.

Marine Gears—
Sizes, capacities and reduction ratios for engines from 40 to 500 hp
—600 to 2500 rpm range. Fluid Coupling or Rubber Block Drive available.





Three-Stage and Single-Stage Torque Converters—Three-stage in 5 Series to 1000 hp, with 33 specific torque ratings. Single-stage in 2 Series to 212 hp, each with 5 specific torque ratings. Wide variety of input-output arrangements for all power units and industrial applications. Bulletins 135-F and 508 and Supplements.

Today, Twin Disc is the world's largest exclusive manufacturer of a complete line of Friction and Fluid Drives for industrial powered equipment. If you have a problem, consult Twin Disc Clutch Company, Racine, Wisconsin, Hydraulic Division, Rockford, Illinois.



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OCTOBER 1959

POWER TRANSMISSION DESIGN

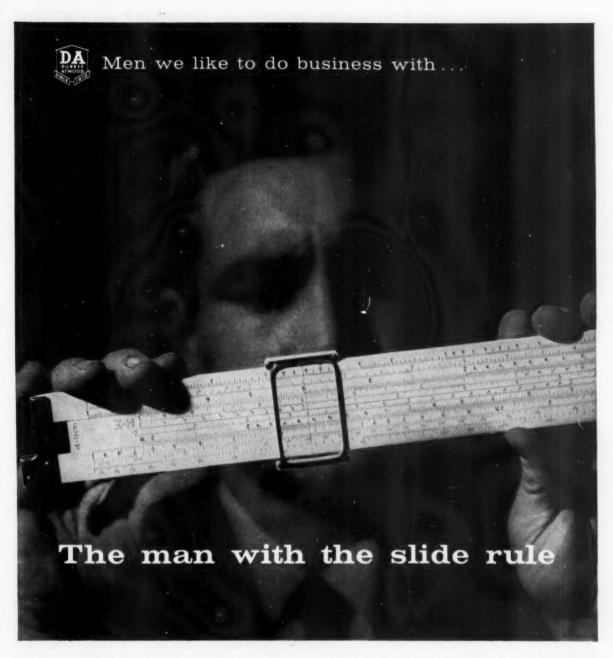
volume 1 number 10



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That's the kind of man we like to do business with, because we can show him exactly how he gets extra benefits with Durkee-Atwood V-Belts. Durkee-Atwood offers V-Belt Quality that meets the most demanding needs of industry, quality that has proven

itself under severe usage . . . prompt Service when you need special attention and help . . . real money Savings, too (and the eyes of the "slide rule" man light up at that).

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engineered by experts in automatic torque control

1







Call on a specialist for answers to your power transmission problems. Mercury is one of the nation's most authoritative exponents on clutch design. Somewhere in Mercury's complete line of precision-built, standard automatic clutches (with exclusive MercoTorque action), or from among over 5,000 configurations is the perfect clutch for your design.

Request catalog #BL-1 or see Sweet's Product Design File

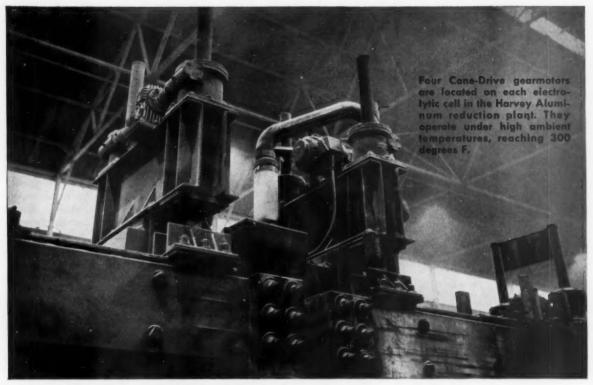
A Mercury engineer will be happy to sit down and work with you with an eye toward improving product quality and saving you money. Rush us your points call us in for detailed recommendations. No matter what the application, for anything from air-conditioning to helicopters, a dependable Mercury Cutch will make it better.

MERCURY

MERCURY UTOMATIC CLUTCHES

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1,000 CONE-DRIVE Gearmotors to produce 100,000,000 lbs per year at Harvey Aluminum



Four double-enveloping worm gearmotors used by Harvey Aluminum are shown here after test run in Cone-Drive plant. They were palletized in groups of four for shipment to Oregon smelter.

From its modern reduction plant at The Dalles, Oregon, Harvey ships primary aluminum in pig, ingot and billet forms all over America. The smelter includes the latest and most efficient equipment and operating techniques. Reflecting this modern equipment are 1,000 Cone-Drive double-enveloping worm gearmotors, used to control the height of anodes and casings in relation to the molten aluminum bath in each of the electric furnaces. Annual capacity is more than 100-million pounds.

The gearmotors are operated under high ambient temperatures that reach 300° F. This was an important consideration in Harvey's selection of Cone-Drive gearmotors. In addition, the ability to withstand the full force of stalled driving motors and constant reversing operations figured in Cone-Drive gearing's selection.

Cone-Drive double-enveloping worm gearmotors are available in a wide variety of styles and sizes. Models include standard shaft or hollow shaft with worm over or under or gearshaft vertical. Capacities range from ¼ to 40 HP and reductions from 3.3:1 to 240:1. Ask for Catalog No. 58 for complete specifications.

CONE-DRIVE GEARS DIVISION MICHIGAN TOOL COMPANY

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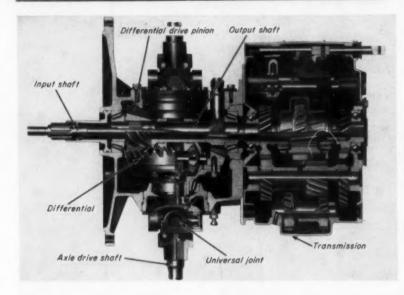






For more information circle No. 6 on Reader Service Card.

NEWS from the power transmission field



New small Chevy has unconventional drive

DETROIT, MICH.—Chevrolet's Corvair, their just introduced small car, has engine and complete drive package mounted in the rear. This has forced changes in the power transmission system which are quite unconventional for a U. S.-made car.

Engine, behind the transmission and differential, drives forward through a shaft above the differential gearing. The transmission input shaft and output shaft are coaxial. Transmission output then comes back from the same end of the transmission to drive the differential.

Drive from the differential to the independently-sprung rear wheels is through swinging axles with two universals and a slip joint.

Transmission and differential hous-

Boston Gear expands

QUINCY, MASS.—Boston Gear Works has completed and occupied a new building for its Dallas branch. Modern office and warehouse with expanded stock storage area and improved shipping facilities will provide service throughout the Southwest.

ings are fastened together as a unit with the engine to make a complete power package. The differential is between the engine and the transmission.

Engine is flat, opposed six. It develops 80 hp at 4400 rpm. Air cooling and extensive use of aluminum reduce weight by 40% over conventional engines of equal horsepower.

Better checking of bevel gears

ROCHESTER, N. Y.—A new method for checking bevel gear blanks has been developed at the Gleason Works in Rochester. The method involves a new system of inspection tolerances, by which an important source of error is eliminated, and is accomplished by the use of a No. 15 bevel gear blank checker—one universal fixture for accurately checking all bevel and hypoid gear blanks.

The new system eliminates the crown as a reference surface, since this surface is hard to locate accurately once a radius is turned on the crown. It deals only with face angle and back cone angle.

Dayton Rubber unites overseas efforts

DAYTON, OHIO—A new division has been formed to unite all overseas activities of the Dayton Rubber Company, according to president Clowes M. Christie.

The new division will be known as Dayton Rubber International, with headquarters in Dayton. Richard D. Rosenberg, formerly a staff assistant with the firm's executive office, will direct all of the division's activities.

Dayton Rubber International will embrace Dayton Rubber's current Foreign Technical Service Program as well as the export operations involving product shipping to 45 countries. Responsibility for Dayton Rubber's two foreign subsidiaries, in Dundee, Scotland and Toronto, Ontario, also will come under the new division.

"One of the major purposes of this move is to implement and strengthen a program of licensing for manufacture of Dayton Rubber's patented and trademarked items," Christie said. Rosenberg is now on a world tour designed to carry out this new program.

AGMA examines doubleprice discrimination

WASHINGTON, D. C.—A recent News Digest of the American Gear Manufacturers Association considers the legality of bearing manufacturers' maintaining two price lists—one for bearings to be installed in original equipment, the other for bearings to be resold as spares, repair parts, etc.

AGMA counsel advises that the issuance of two lists is in line with recent decisions of the Federal Trade Commission. The Commission has held that a manufacturer of automobile replacement parts is guilty of selling at discriminatory prices if he sells parts to automobile manufacturers at a lower price than is charged jobbers, but only if the automobile makers resell some of their parts for repair purposes in competition with the jobbers. Under the Commission's decision a lower price can be charged the car manufacturers for parts to be used in original equipment.

This decision affects all manufactures who sell parts to other manufacturers who, in turn, use some of the parts for resale purposes.

Standards group considers inch-metric conflict

NEW YORK, N. Y.—Difficulties of establishing international standards because of the existence of two systems of linear measure—the inch and the metric systems—were eased somewhat by the work of a recent conference of standards experts in Rumania.

The Standing Committee for the Study of Scientific Principles of Standardization, meeting in Bucharest, adopted a resolution which established the principle that wherever possible, only one series of linear dimensions should be used. Then, in order of preference, a single series derived from one system but expressed in both by exact translation: a series composed of a selection of existing sizes, some metric and some inch; and last a series that permits interchangeability between inch and metric sizes even though the two series do not have identical dimensions in all respects.

Eaton absorbs Eastern sales unit

CLEVELAND, OHIO—Eaton Mfg. Co. has absorbed the organization of Gregg & Associates, formerly an independent sales agency which has been serving the company's Dynamatic Division in the New York region for the last ten years.

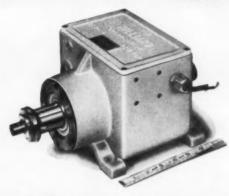
The Gregg corporation will handle Dynamatic's complete line of electrical products consisting of eddy-current Adjusto-Speed drives, couplings, brakes and dynamometers with a wide range of industrial application.

McCauley transmission division named Elmag

DAYTON, OHIO—"Elmag" is the new name of the McCauley Industrial Corporation power transmission division. Dr. Walter Rudisch, vice president in charge of McCauley electromagnetic clutch operations, emphasized that the new name infers no change in the management or production organization but is simply a move toward a stronger corporate image for the division.

Continued on page 26

HILLIARD'S New"L.D.U."



A complete, packaged unit that gives you precise control of intermittent motion from a constant rotary power source!

Built-in features:

- Contains all the parts in one package.
- Can be installed as easily as a motor and needs only electrical connection.
- Self-lubricating for long life of 40,000,000 or more cycles.
- Operating speed from 40 to 400 R.P.M.
- Torque capacity 36 ft. lbs.
- No cumulative error in cycling.
- Instant engagement.
- Mount with direct coupling connection or use with belt, chain or gear drive.

Can be installed on existing equipment, designed into new machinery and re-used after production line changes.

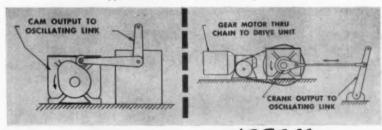
A single package unit that gives you precise control of intermittent motions . . . oscillate or repeat . . . clip and bend . . . shear or slash . . raise or lower . . . index and position . . . from a constantly rotating source of power.

of power.
HILLIARD "I.D.U." eliminates the need
of buying separate parts and assembling a
"custom" machine with assorted mechanisms
to control it.
"I.D.U." features highly flexible control—

"I.D.U." features highly flexible control—manual, mechanical or electrical—permitting "demand" type operations in fixed or variable cycles. A protected drive, totally enclosed in an oil bath housing, it is ideal for dusty, "steamed" or "washdown" conditions.

Write on your letterhead stating your intermittent motion problems and we will provide complete information.

Typical intermittent controls by "I.D.U"



Basic Unit Price \$289.00

Optional accessories extra

The HILLIARD Corporation

214 W. FOURTH ST.

ELMIRA, NEW YORK

TRANSPORTE A PROPERTY AND A STATE OF A PROPERTY AND A STATE OF A S

MEN of the power transmission industry





Bannan

Butler appointed GE sales manager

SCHENECTADY, N. Y.—John M. Butler, Jr., has been appointed sales manager of General Electric's small ac motor and generator department in Schenectady.

In his new position, Butler will be responsible for the department's industrial user, defense, internal and export sales. He will also handle sales of generating equipment built by the department on a contract basis.

Gorham named midwest manager for Bendix

DETROIT, MICH.—Jay C. Gorham is the new midwest regional manager for the Industrial Controls Section, Bendix Aviation Corp., Detroit. He will be in charge of sales of Bendix numerical control systems for machine tools in the midwest area. Gorham was associated with the Kaydon Engineering Corp. until 1959.

American Pulley names sales executives

PHILADELPHIA, PA.—New appointments at American Pulley Co. include those of John C. Bannan as assistant sales manager and John West as eastern sales manager.

Bannan joined American Pulley in 1957 as advertising manager, having served as a consultant prior to that time. As assistant sales manager he will be responsible for all staff functions including advertising and customer services.

West, who has had twenty-four years of experience in various areas of the industrial supply field, comes to American Pulley from Warren, Balberston Co., Trenton, N. J., where he was vice president in charge of

Backus is Clark Controller manager

CLEVELAND, OHIO—William J. Backus has been promoted to manager of the Cincinnati district office of the Clark Controller Co., Cleveland. Clark designs and manufactures standard and special electrical control systems and components.

Backus, who has been with Clark for thirteen years, replaces James Orton. sales. Previously he was a vice president of Lewis Supply Co., Memphis, Tenn. As eastern sales manager he will be responsible for sales of both the power transmission and materials handling divisions of the company for the entire territory east of the Mississippi.

Bujold becomes Kaydon division manager

MUSKEGON, MICH.—Frank X. Bujold has been named general manager of Frauenthal Division of the Kaydon Engineering Corp. Until his recent appointment, Bujold was manufacturing manager of foundries, Engine and Foundries Div., Ford Motor Co.

Market manager at Foote Bros.—Whitney Chain



Korder

CHICAGO, ILL.—Walter O. R. Korder, formerly general sales manager of The Whitney Chain Co., Hartford, Conn., a subsidiary of Foote Bros. Gear and Machine Corp., has been appointed general marketing manager in charge of both Foote and Whitney operations.

Korder is a graduate of Sheffield Scientific School of Yale, and holds a Master's Degree in business administration from the Harvard Business School. He became general sales manager of Whitney in 1955, relocating to Chicago when Whitney became a subsidiary of Foote Bros.

In his new position as marketing manager of both companies. Korder will be in charge of an expansion program for Foote and Whitney.

Formsprag picks Cherry for Western manager post

DETROIT, MICH.—Recognition of the West Coast area as one of its important industrial markets was recently given in Formsprag Co.'s appointment of William T. Cherry as district manager.

According to Charles F. Trapp, vice president of Formsprag, Cherry will manage sales activities in California, Oregon, Washington, Arizona and the cities of Denver and Salt Lake City. He will headquarter in Los Angeles.

Cherry has been manager of application engineering for the past nine years and has had particular experience with over-running clutch applications in the aviation and missile fields. Formsprag is the world's largest manufacturer of over-running clutches.

In announcing the appointment,



Hanau



Rozner



Cherry

Trapp emphasized that the concentration of aircraft production in the West Coast area called for an accomplished engineer as manager.

Industrial Tectonics names engineering director

ANN ARBOR, MICH.—Heinz Hanau has been named director of engineering and research of Industrial Tectonics, Inc., Western Division, Compton, California.

Hanau began his engineering career in 1944 with Ranger Aircraft Engines. For the past nine years he has been associated with New Departure, Division of General Motors, most recently as supervisor of aircraft projects.

Rozner new president at Aetna Bearing

CHICAGO, ILL.—J. J. Rozner has been elected president of the Aetna Ball and Roller Bearing Co. by the directors of the parent corporation, Parkersburg-Aetna. He is also a vice president and member of the Board of the Parkersburg-Aetna Corp.

As executive vice president of Aetna Ball and Roller Bearing, Rozner directed the progress of the company in an enlarged development and diversification program during recent years. He formerly served as chief engineer, works manager and vice president in charge of operations.





Your Browning distributor stocks a wide range of couplings designed to provide maximum strength and compactness. You get off-the-shelf service on scores of size and bore combinations, through Browning's exclusive malleable split taper bushing . . . which interchanges in Browning couplings, sheaves, sprockets, paper pulleys, and always assembles easily with vise-like grip on the shaft. Many fixed-bore couplings also are available, plus minimum-bore chain type. Ask distributor or write us for free catalog C210, which contains full details. Browning Manufacturing Company, Maysville, Kentucky.



For more information circle No. 31 on Reader Service Card

LETTERS

Address letters to: The Editor Power Transmission Design 812 Huron Road, Cleveland 15, Ohio

Gentlemen:

Since the time I saw your very first, issue I have eagerly awaited and enjoyed each succeeding issue. Your magazine doesn't come to me personally and I only read it as it goes through. This presents a problem because the August 1959 issue had so many articles which I would have liked to have had that I was ashamed to fill out the reader service card.

I would certainly like to continue reading your magazine for it has been quite beneficial to me already. I would be very appreciative if you would place me on your complimentary mailing list.

G. P. DAVIS, JR.
Spruance Plant
E. I. Du Pont De Nemours & Co.
Richmond, Va.

Gentlemen:

The article on page 37 of the July 1959 issue seems to me to need an explanation to your readers.

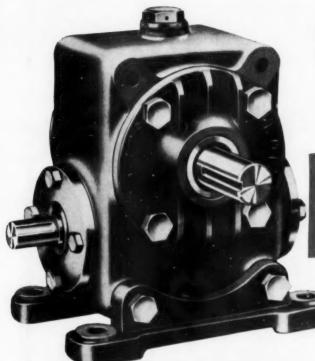
The last sentence of the second paragraph reads: "Door on the far side had to travel as fast as the near door . . ." Then paragraph 3 says that the near door moves at one-half foot per second and the fourth paragraph says that the far door travels at one foot per second. The upper righthand photo seems to show that the chains are connected to the doors so how can the doors travel at the same speed if the chains connected to them travel at different ones?

Please point out what is wrong with either this article or with me.

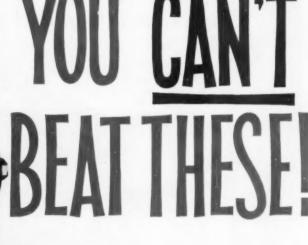
ROGER J. KENNEY Curt G. Joa, Inc. Lake Wales, Fla.

Mr. Kenney is correct. The second paragraph should have read "twice as fast" instead of "as fast" in order that the doors reach closing position at the same time.

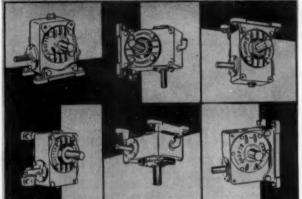
We apologize to Mr. Kenney and to others of our readers who noticed this error.—Ed.



ALTERNATIVE FOOT MOUNTING POSITIONS



CROFTS UNIVERSAL MOUNTING WORM GEAR REDUCERS



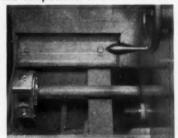
You just can't beat these small, rugged worm gear reducers. They can be mounted anywhere, in practically any position, and left alone to do their job.

Developed, tried and proved throughout North and South America, Crofts Universal Mounting Worm Gear Reducers and Gearmotors are available from stock in sizes I-1/8", I-3/4", 2-1/4" and 3" centers; up to 6 hp.; ratios up to 60:1.

For general information request Speed Reducer Bulletins 571 (single reduction), 5744 (double reduction) and Gearmotor Bulletin 5914. We will be pleased to make recommendations on your speed reduction problems.

Typical installations showing the versatility and compactness of Crofts Universal Mounting Worm Gear Reducers.







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For more information circle No. 7 on Reader Service Card.

Tough New Trojan with a bigger bite...



Another Leader chooses

ROCKWELL-STANDARD PLANETARY AXLES AND HYDRA-DRIVES® POWER SHIFT TRANSMISSION!

It would have to be rugged and ready . . . give fast, economical operation . . . and be a top producer on even the "problem" jobs.

Given these rigid tractor shovel requirements, Yale and Towne engineers came up with the answer: the new 3-yard Trojan* Model 304 shown here.

For an important part of their answer, Yale & Towne drew upon the experience and resources of Rockwell-Standard Corporation engineers. Rockwell-Standard's Transmission and Axle Division supplied the manufacturer with readily available to the transmission of Yale & Towne Manufacturing Co.

able drive components that met the exacting specifications.

By equipping its Trojan heavyweight with Timken-Detroit Planetary Axles, both rigid and steering—plus a Hydra-Drives BDB Full Power Shift Transmission and Torque Converter—Yale & Towne avoided the time and expense involved in designing, engineering and building custom-made components.

If you have a power transmission and propulsion problem, call on Rockwell-Standard. It costs you nothing. It may save you time and money.

Another Product of ...

ROCKWELL-STANDARD

CORPORATION



Transmission and Axle Division, Detroit 32, Michigan

For more information circle No. 24 on Reader Service Card.

PATENTS

Adjustable sheaves

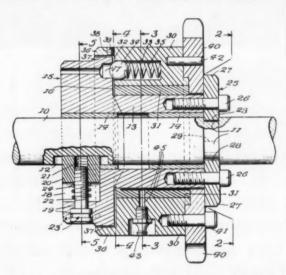
U. S. Patent No. 2,870,641; Bernard R. Bellman and Ernest Voris, Dayton, Ohio, assignors to the Dayton Rubber Co., Dayton, Ohio.

For use with V-belts, this pulley has a hub with opposite-hand threads on each half of its external surface, and a keyway in its inner surface. The two sheave halves are threaded to mate with the threads on the hub. A pin in one sheave half extends into a hole in the other sheave half. The hole in one sheave half is a loose fit so the pin can slide in the hole. Thus, as one sheave half is rotated, the other half is driven by the pin and the opposite-hand threads cause the two halves to move toward or away from each other to change pitch diameter but maintain the belt centerline.

Overload release clutch

U. S. Patent No. 2,866,325; Edward W. Wagner, Maywood, and Charles W. Stetter, Paterson, N. J., assignors to Continental Can Co. Inc., New York, N. Y.

Cylindrical hub has an enlarged head at one end with a socket into which a spring-loaded ball fits. Spring and ball are contained in a bore in the driven member



which has an integral sprocket. The spring-loaded ball is the connection between the members. A thrust plate fastened to the inner sleeve retains the sprocket and driven member. When torque exceeds a certain value, the ball is forced out of the socket in the driving sleeve and the clutch slips.

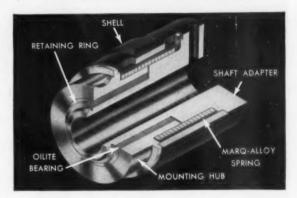
Continued on page 56

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- Instantaneous and non-slipping grip with special Marq-alloy steel spring
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- Compact, light weight. Low first cost and no maintenance or lubrication required
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- ON-OFF CLUTCHES provide intermittent drive from constant power source
- ON-OFF INDEXING CLUTCHES provide intermittent drive and have an integral brake for controlled stopping action
- Available in 8 sizes: $\frac{1}{8}$ " bore to 1" bore: 8 lbs.-in. to 1250 lbs.-in. torque capacities
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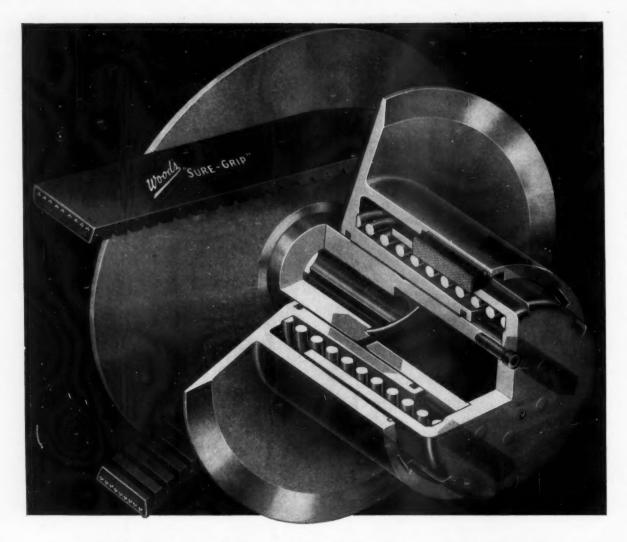
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new, revolutionary, unique—won't freeze, won't stick—Here, for the first time, is a variable speed sheave that won't freeze, won't stick. It's Wood's new "MS" motion control sheave and it completely eliminates problems resulting from fretting corrosion. No more downtime, running through the speed range or dismantling. And, under normal operating conditions, the oil reservoir requires checking only twice a year. These startling advantages are made possible by two exclusive and revolutionary features . . . Wood's resilient rubber keys and continuous, rotational oil pumping action. Don't miss these and many other advantages.

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WHEN YOU NEED MORE MOTOR IN LESS SPACE

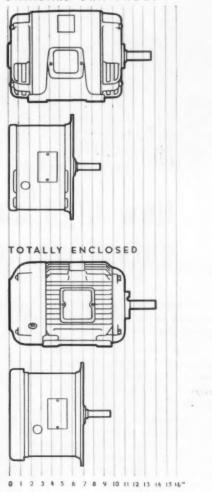
If your problem is how to put more motor in less space, this Peerless Space-Saver may be the answer. The line includes both drip-proof and totally enclosed designs in ratings from ½ to 10 HP. Bearings are pre-lubricated, double-shielded type. Peerless will work with you to build in any special requirements—torque, mounting, enclosure, duty, or insulation. Peerless Space-Savers cataloged in Bulletin SP-1 meet all NEMA performance standards.

Peerless is a specialist in OEM applications. Close cooperation with your engineers assures the development or selection of the one motor that powers your product. There's a Peerless sales engineer near you. If you don't know him, write to Peerless,





STANDARD DRIP-PROOF



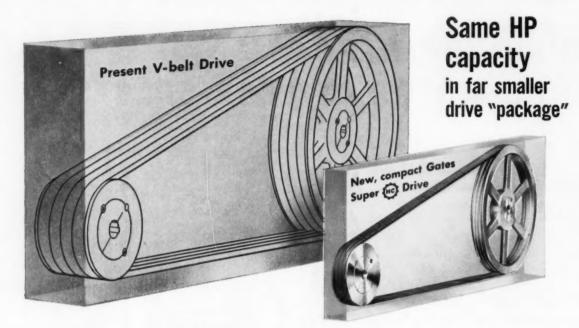
WRITE FOR Bulletin SP-1. It gives complete data on Peerless Space-Savers and lists nearby Peerless sales engineers.

ELECTRIC MOTOR DIVISION

THE Peerless Electric COMPANY

FANS - BLOWERS - MOTORS





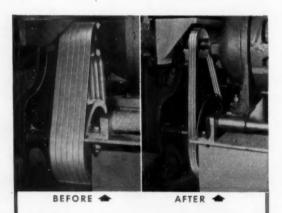
New high capacity V-belt cuts drive cost as much as 20%

Reduce size, cut costs! Gates new Super HC V-Belt Drive puts power transmission in a smaller package—cuts costs all along the line!

With Gates Super HC V-Belt Drives you use fewer belts, smaller sheaves. Sheave diameters and widths are reduced 30% to 50%; center distances 20% and more; weight is substantially reduced. *Initial drive cost is cut as much as* 20%.

Furthermore, as every designer knows, a more compact drive insures other savings, too. Smaller housings, bearings, bases and other components cost less; machining time is often reduced; shipping costs are lowered. And finally, the ultimate user gets the benefit of lower maintenance costs—less down time!

"The Modern Way to Design Multiple V-Belt Drives" is an informative handbook on Gates major advance in power transmission—the Super HC V-Belt Drive. Your nearby Gates Distributor—listed under Belts or Belting in your phone book Yellow Pages—will be glad to furnish a copy of this handbook.



COMPARE: Conventional drive at left was replaced with Gates new Super HC V-Belt Drive at right. Three of Gates new, narrow HC V-Belts do the work of the former 6 standard width belts. In this application the new drive actually takes one-third the space of old!

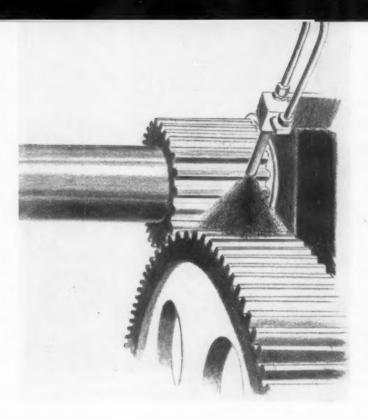
TPA 391



The Gates Rubber Company • Denver, Colorado Gates Rubber of Canada Ltd., Brantford, Ontario

Gates Super HC V-Belt Drives

For more information circle No. 11 on Reader Service Care



For the No. 1 gear problem, here's how to . . .

Increase life of open gears with spray lubrication

THERE ARE TWO TYPES of spray systems: manual and automatic. Manual systems are used where the attendant can be depended upon to operate the system and where one spray shot will last for a given period.

Automatic systems have mechanical or electrical timers that control timing sequence and eliminate human responsibility from the operation.

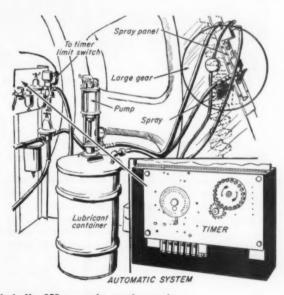
In the manual system, the spray equipment is generally mounted on or near the gear guard. A pump handle builds up operating pressure and is placed accessible to the operator. Between 60 and 80 psi air is usually required. A gage on the unit indicates pressure. Approximately $\frac{3}{4}$ in. air line or larger is usually used. Operating sequence is as follows.

With sufficient lubricant in the supply reservoir, the pump handle is pumped back and forth to force lubricant through one of two supply lines to a recording device and to two measuring valves. Pumping pressure required depends on consistency of the lubricant, temperature and pump speed. As lubricant is discharged, it advances to the spray nozzles in metered amounts. When the indicator stems move up or down, a metered amount has been sprayed and the cycle stops.

AUTOMATIC SYSTEM operates without attention. Timer controls cycles, actuates alarm if system fails to function.

During each cycle, the spray system controls the air that atomizes the lubricant at the discharge nozzle.

Continued on next page

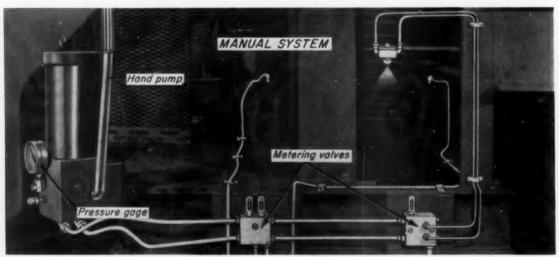


For complete data on spray systems, circle No. 325 on reader service card.

POWER TRANSMISSION DESIGN / OCTOBER 1959



TWO-NOZZLE SYSTEM is shown in action, keeps open gears in service for many extra years.



MANUAL SYSTEM is hand-operated, applies metered amount of lubrication when actuated.

The result is a controlled spray of the right mixture of lubricant and air, independent of the operator pumping action.

In the automatic system, a time clock starts each cycle by energizing a solenoid-operated air valve. Air is applied to the pumping unit which delivers lubricant to the inlet port of the reversing valve. The reversing valve directs lubricants alternately to either of two supply lines and stops after each spray cycle.

The measuring valves are mounted close to the nozzles and send a metered amount of lubricant

through the discharge lines. The lubricant is atomized with air outside the spray nozzles where atomization of the lubricant takes place. Adjustment at the valve controls amount of air needed.

After each cycle, pressure in the return lines actuates pistons in the reversing valves that trip limit switches and shut the system down until the next cycle. The reversing valves reverse awaiting the next cycle controlled by the clock. Automatic timers usually have failure signal devices that energize warning lights or alarms if lubricant does not discharge.

Several known lubricants that work successfully are listed in the chart. Many others can also be used. The major operational factor of the lubricant is pumpability for all conditions, such as temperature, air pressure, nozzle-to-gear distance and type of nozzle.

There is a general formula to calculate air consumption for the pump

$$C_a = \frac{V_n \, x \, V_c \, x \, S_h \, x \, A_c}{L_{st}} \,(1) \label{eq:capprox}$$

where

A_c = air consumption per pump stroke, cu ft.

C_a = air consumption of pump cu ft/hr

L_d = amount of lubricant per pump stroke, fl oz

S_h = number of valve operations per hour

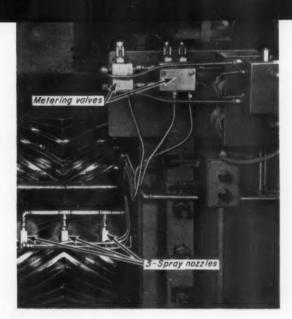
V_c = valve discharge capacity, fl oz

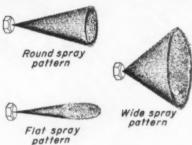
V_n = number of valves

There is a similar formula to calculate air consumption for each nozzle. A 100% safety factor should be used for air to assure sufficient supply at all times.

Spray systems cut down on lubricant waste, eliminate hand methods such as swabbing, squirting and drip feed, and improve safety and cleanliness for open gears.

METERED LUBRICANT is applied to open gears, increasing safety and reducing waste.



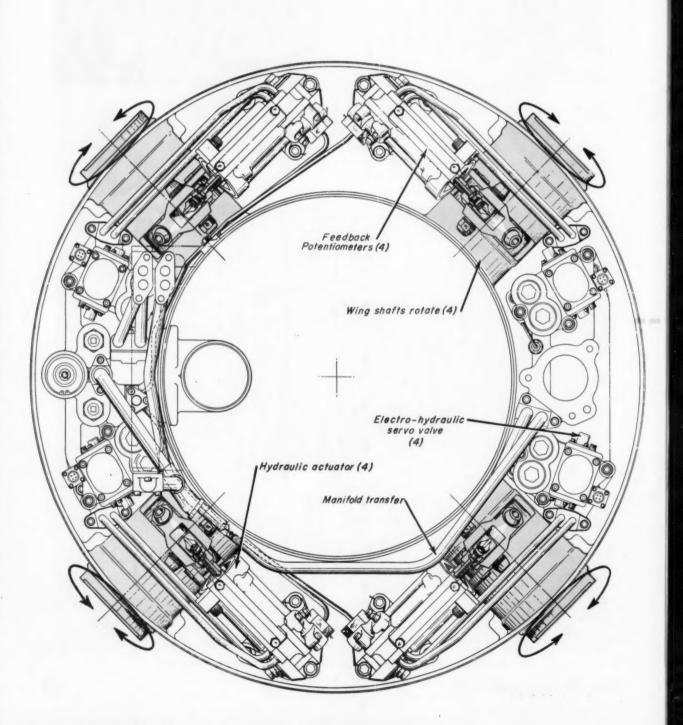


x - WITH DILU y - WITHOUT						HER	EARE	A FE	W AV	ILAB		RAY	LUBRICA	ANTS F	OR ALL	TYPES	OF APP	LICATI	ONS					
SUPPLIER	BRAND NAME	MLGI	PENETRATION ASTM		VISCOSITY SSU °F		Y	VISCOSITY DIF °F			DROP POINT OF	°F	CHANNE L POINT	POINT	COLOR	SPECIF.	"API		SULPHUR	ASH	BASE	ADDITIVES	SOLVENT	ARZ"
		COMS.	W.	U.W.	210	130	100	210	122	100	ASTM	(COC)	.k	,Ł		GRAVITY	GRAVITY		8	2			5	MUEA
SHELL	CARDIUM COMPOUND F			325				205.				515		70	BLACK	,9861		NIL					NO SOLVENT	
TEXACO	CRATER 00				200					744		390			BLACK	.9478	17,8		.69	,000				
TEXACO	CRATER 2X FLUID								117						BLACK	1,0639	1,5		1,77	,039			20	
TEXACO	CRATER SX FLUID								185						BLACK	1,0671	1,1		2,02	,038			20	
SOCONA SOCONA	DORCIA III							y 200 250	100 150						BLACK		4,0							
NOBIL SOCORY	DORCIA 30							y 900	X 300						BLACK	1.15								
SOCONY MOBIL	DORCIA 90								100 150															
MOBIL SOCONY	DORCIA 150							700 800	1250 1650						BLACK		5,0							
IMPERIAL OIL & GREASE CO	MOLUB- ALLOY MEDIUM		310		90						NONE	400		0							SPEC. MON- SOAP	MOLUB- ALLOY MoS ₂		
WHITWORE	LIQUID GEAR COMPOUND						2950			298				0								WHITWORE	15	
STANDARD OIL INDIANA	CALUMET VISCOUS 8X	1	305		190										BLACK FIBROUS TACKY									
BROOKS	KLINGFAST XX LIGHT				X 250							350	0	10	BLACK									
BROOKS	KLINGFAST SPECIAL EXTRA LIGHT				250							150	.10	0	BLACK									
STANDARD OIL OF N. J.	SURETT FLUID # 20				^X 460 ^Y 2400																			
ATLANTIC	LUBRICANT #88		340								200											E.P.	DILUTED WITH SOLVENT	
TEXACO	MEROPA #8				409	4549	17339					570		25							LEAD SOAP			80

For complete data on spray systems, circle No. 325 on reader service card.

How to use hydraulics to

By E. A. SHERRILL, chief hydraulic engineer, Bendix Products Div.-Missiles, Bendix Aviation Corp.



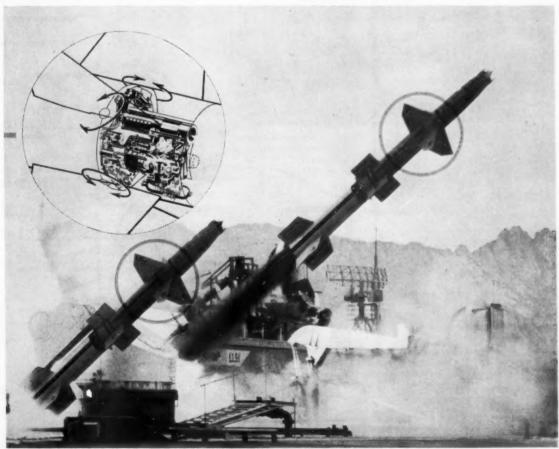
produce multiple shaft rotation

FLIGHT CONTROL SURFACES (wings) are rotated hydraulically in a new surface-to-air guided missile. The four surfaces rotate in both directions and independently of each other to guide the missile during flight.

Rotation of the wings is caused by extension of actuator pistons. The pistons extend or retract in response to hydraulic signals from a servo system. Linear potentiometers on top the actuators return feedback signals to the servo system showing actual wing shaft position.

The missile is the Talos, produced under a Bureau of Ordnance, Department of Navy contract. It has solid-fuel booster rocket that separates from the missile prior to the flight phase of the missile itself. During the boost phase, hydraulic pressure is generated by compressed nitrogen acting in an accumulator. This is necessary since the hydraulic pump for the servo system does not come into play until ram air speed builds up to drive it.

Continued on next page



WING SURFACES of Talos are rotated hydraulically for guidance. System is pressurized by compressed nitro-

gen during boost stage and by turbine-driven pump during flight stage.

When in-flight stage is reached, the ram jet engine takes over for main propulsion, and ram air takes over from the nitrogen to drive the impulse-type turbine and hydraulic pump.

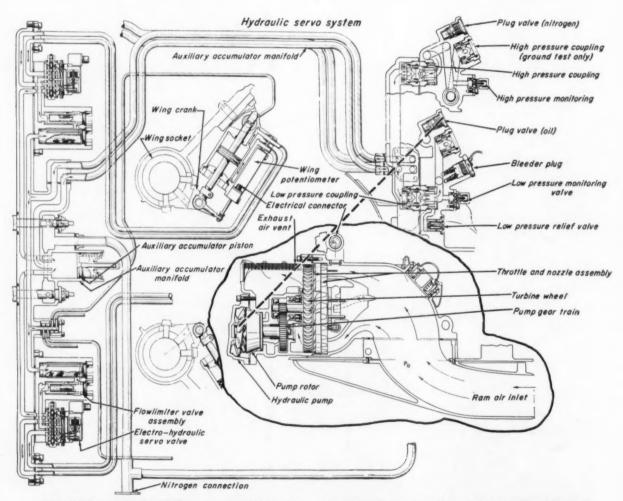
The pump has a rotor housing and seven pistons. Valving of oil is accomplished by rotation of the rotor over a pair of kidney-shaped ports in a fixed valve port plate. Piston passages are exposed to the inlet port on the upstroke and to the discharge port during downstroke. The pump and gear train are lubricated by a small flow of hydraulic oil.

Oil under pressure for each actuator is supplied by the pump through hydraulic servo control units. Servo valves dictate the rate of piston advance in the actuators obtained from electrical signals of the guidance circuit and from feedback signals supplied by the potentiometer mounted integrally with the actu-

On approaching final wing position, the servo valves move to null position closing sleeve ports and hydraulically locking the actuators and wing shafts in steady-state position.

The actuators are pivoted at their bases on pins to transmit force along a pivoting centerline as rotation takes place. At the piston end they are connected to the wing shafts fastened to the wing sockets. At the pin end, they pivot in a saddle assembly.

The ram jet engine of the Talos supplies over 100 hp/lb as opposed to approximately 2½ hp/lb for reciprocating engines.



ROTATION OF WING SHAFTS is controlled by hydraulic pressure acting on both sides of actuator pistons. Linear potentiometers on top of actuators return feed-

back signals to system. Ram air drives turbine wheel and pump to pressurize system during in-flight stage; compressed nitrogen during boost stage.

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WITH TIMKEN BEARINGS

America's super-quality linewith a 35 year record of keeping performance up and costs down! Five types—to fit practically any service condition. All assembled, adjusted, lubricated and sealed at the factory for precision performance-long life — dependability.



SPECIAL DUTY TYPE

- Designed for extreme precision and high load capacities.
- Fully self-aligning.
- Special Duplex Timken Roller Bearing with tapered bore.
- Split tapered sleeve with straight cylindrical bore extends through entire length of housing.
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- Special dust cap protects lubrication fitting.
- Shaft sizes 1% to 8°. Ask your local Dodge Distributor—or write us for Bulletin A670 glving complete technical data on America's most complete line of mounted bearings. bearings.

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CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the white pages of your telephone directory for "Dodge Transmissioneer."

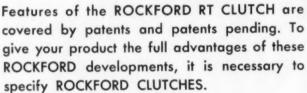




For more information circle No. 33 on Reader Service Card

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Don't be fooled by any "copy" or "imitation." The Genuine ROCKFORD CLUTCH is what YOU want. The ROCKFORD CLUTCH has the needed skill and long years of experience behind it.

Let our engineers help you determine the type and size clutch best suited to help improve the power transmission control in your next model.



SEND FOR THIS HANDY BULLETIN

Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

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Automotive



Heavy Duty Spring Loaded



Oil or Dry Multiple Disc



Heavy Duty



Light Over Cente



Take-Offs



Speed



NEWS continued from page 9

Vernitron to produce servo components

NEW YORK, N. Y.—The formation of a new prime source in the design, development and production of servo components for military and commercial applications is announced with the organization of Vernitron Corp. Engineering and manufacturing facilities of the company are located in Torrance, California, with executive offices and research and development operations in New York City.

Plans call for design and building of synchros, resolvers, servo motors and tachometers as components only, though engineering talents will be available to firms producing weapons systems, automation equipment and other servo controls.

Lipe announces clutch change-over program

SYRACUSE, N. Y.—A large-scale interchange of automotive clutch assemblies has been introduced by Lipe-Rollway Corp., Syracuse. The company, which has been manufacturing heavy-duty automotive clutches for 30 years, will open up its entire line to exchange with other leading makes.

Company official states that core credit allowances for competitive makes will serve to stimulate longer equipment life and a greater return on investment among fleet owners, construction firms and other large-volume users. The expanded core program will also permit a reduction in initial cost for fleets planning complete change-over to Lipe assemblies.

David Brown appoints western distributors

SAN FRANCISCO, CALIF.—Three major western gear distributors for David Brown, Inc., San Leandro, Calif., have been announced by Stuart Walters, general manager.

Handling the David Brown line in Utah and parts of Idaho, Wyoming and Nevada is Bearing Engineering & Sales Co., Inc., Salt Lake City. Montezuma Bearing Co., Albuquerque, will handle the line in New Mexico, and Industrial Electric Service Co., Inc., Arcata, Calif., will service northwestern California.

IDEAS FROM THE FIELD

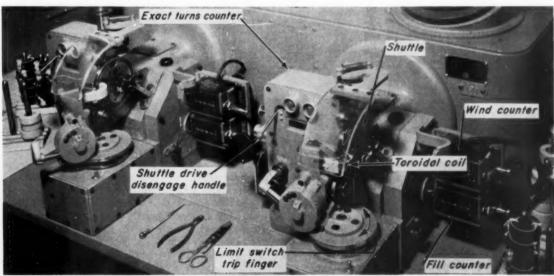
Electric clutches control oscillating drive

ELECTRIC CLUTCHES and miter gears reverse rotation of a toroidal core at intervals from 30 to 180 deg during coil winding operations. Because the cores are a continuous ring and must be clamped at one point, it is impossible to use a continuously operating drive.

Power for the machine originates at a motor which

has 1800 rpm output in the forward direction for winding and 900 rpm in reverse for filling the shuttle with wire. Two pairs of helical gears transmit power from the main drive shaft. One pair drives a variable-speed

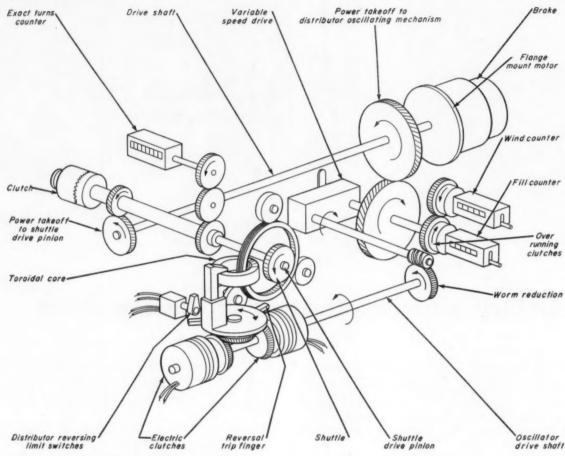
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OSCILLATING DRIVE for winding toroidal coils uses two electric clutches which are alternately engaged and

disengaged. Two of the winders using this system are shown in this photo.

IDEAS



SCHEMATIC of toroidal coil winder drive.

ELECTRIC CLUTCHES continued

transmission and two counters. Overrunning clutches control the counters so one counts forward revolutions and the other reverse.

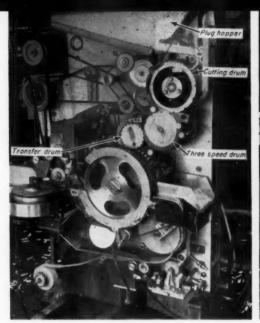
Variable-speed transmission output is fed to a 10:1 worm gear reducer. The transmission ratio is variable from 1:1 to 4:1 reduction. Output shaft of the worm reducer drives two electric clutches. Each clutch drives a miter gear on the same axis. These mesh with a miter gear at right angles to the first two. This last miter gear drives the toroid clamp support. Direction of rotation of the support and toroid is determined by which clutch is energized. Two arms, which rotate with the support, contact cam operated limit switches to reverse the toroid's rotation by deenergizing one clutch and energizing the other. Thus, the drive causes the toroid to oscillate back and forth while the shuttle

revolves to wind the wire around the core.

Shuttle drive is through the other pair of helical gears. They drive a hollow shaft. At one end of the shaft, spur gears drive a counter which shows the total turns of the shuttle. At the other end of the hollow shaft, a toothed clutch connects the hollow shaft to another shaft which runs coaxially through the hollow shaft. The shuttle drive pinion is at the opposite end of the solid shaft. The pinion drives the shuttle through an internal gear which is integral with the shuttle.

The clutch arrangement with the coaxial shafts lets the shuttle drive shaft and pinion be disengaged from the rest of the machine drive from outside the machine housing so the shuttle may be turned by hand during the filling operation and at the beginning of the winding operation.

This machine was developed and is used at the Merrimack Valley Works, Western Electric Co., North Andover, Mass.





CHAIN AND SPROCKET DRIVES synchronize rotation of cutting drum, threespeed drum, and transfer drum to deliver one segment of filter tip material at a time to the transfer drum with three at a time fed to the three-speed drum.

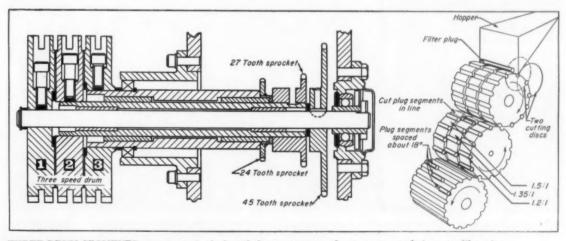
Chain drives synchronize transfer ratios

THREE EXACTLY RELATED SPEEDS are produced by chain drives in a machine for attaching filter tips to cigarettes. The drives rotate 3 segments of a drum that separate three segments of tip material.

Grooves in the three segments receive different lengths of the filter material, or plug. The lengths are in line when fed to the drum. The difference in rotational speeds of the drum segments separates the lengths so they are about 18 degrees apart so they may be fed, one to a groove, to the transfer drum.

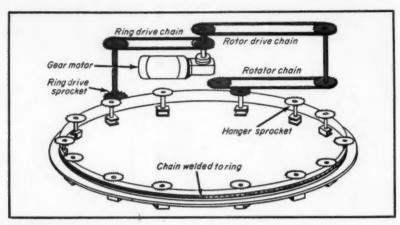
Drum segments are supported and rotated by a shaft and two concentric sleeves. Sprockets driving the shaft and sleeves have 24, 27, and 45 teeth. All three are driven by sprockets mounted on a single adjacent shaft. Numbers of teeth on the drive sprockets produce ratios of 1.2:1, 1.35:1, and 1.5:1 for the rotation of the drum segments relative to the drum which feeds them, the cutting drum.

The machine using this system is a product of American Machine & Foundry Co., Brooklyn, N. Y.



THREE DRUM SEGMENTS on concentric shaft and sleeves separate three segments of eigarette filter tip.





SCHEMATIC of circular conveyor and rotator drive.

Roller chain makes low-cost ring gear

ROLLER CHAIN, about 25 ft of it, welded to an 8-ft ring of angle iron, makes a low-cost ring gear for a circular conveyor. Chain is also used to revolve the hangers for the pieces being carried for painting so they will be uniformly coated on all sides.

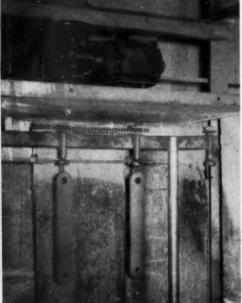
The chain is No. 60. It is tack welded to the ring at 12 in. intervals. The ring is made from 2 x 2 x ½-in. angle iron. The assembly is driven at a lineal speed of 8.1 fpm by a 16.5 rpm gearmotor. Power is transmitted from the gearmotor to the drive sprocket through another chain and sprocket set and vertical shaft. Ring is supported and guided by rollers atop legs fastened to the floor.

The same gearmotor provides rotation for the part carriers by driving a length of chain placed close to the ring so it will engage sprockets on the carriers when at the spraying point. To allow for slight fluctuation in relative height of the rotator chain and sprockets, No. 41 sprockets are used with No. 40 chain. Since the No. 41 sprockets are thinner than No. 40, some change in elevation is possible without undue stress or disengagement.

This system was designed and manufactured by Baldwin Supply Co., Minneapolis, Minn. for Brinktun Inc. of that city.



RING GEAR made by welding roller chain to angle ring. Part carriers with drive sprockets are at top.



ROTATOR CHAIN is shown here with sprockets of two carriers engaging it.



Why Reo's new ready-mix truck (with a flywheel power take-off)



...is equipped with PowerGrip "Timing" Belt



Reo's* new transit mix truck has a revolutionary new flywheel power take-off. This does away with a separate engine or a take-off from the front end to truck engine crankshaft. Reo's take-off is factory designed, and engineered and installed as an integral part of the chassis engine drive. It is at the rear of the engine, ahead of the transmission. Only U. S. Rubber's PowerGrip "Timing"® Belt can deliver the positive, smooth, direct, even-flowing power desired by Reo's engineers. PowerGrip "Timing" Belt eliminated the need for lubricants and the possibility of oil leaks. This

positive drive belt is an essential, functional part that helps bring to the transit mix operator a payload increase from 400 to 600 lbs. per trip.

The efficiency and the freedom from maintenance that U. S. Rubber's PowerGrip "Timing" Belt has brought to this new revolutionary Reo drive has been demonstrated repeatedly on original equipment and replacement drives. Your U. S. Rubber distributor and "U. S." transmission engineers stand ready to help you with any transmission replacement or design problems.

Div. of White Motor Co., Lansing, Michigan



Mechanical Goods Division

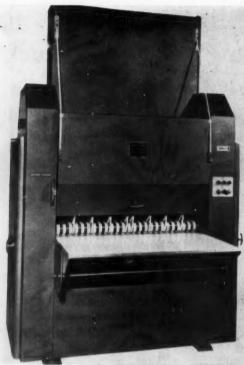
United States Rubber

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

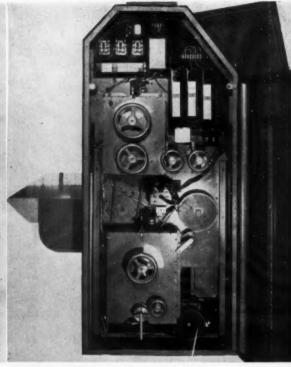
Rockefeller Center, New York 20, N.Y.

In Canada: Dominion Rubber Company, Ltd.

For more information circle No. 26 on Reader Service Card



REDUCING CAMERA uses two unusual speed changers.



HAND WHEELS for shifting speed changer are shown in this side view.

IDEAS

Gears on discs give adjustable speed

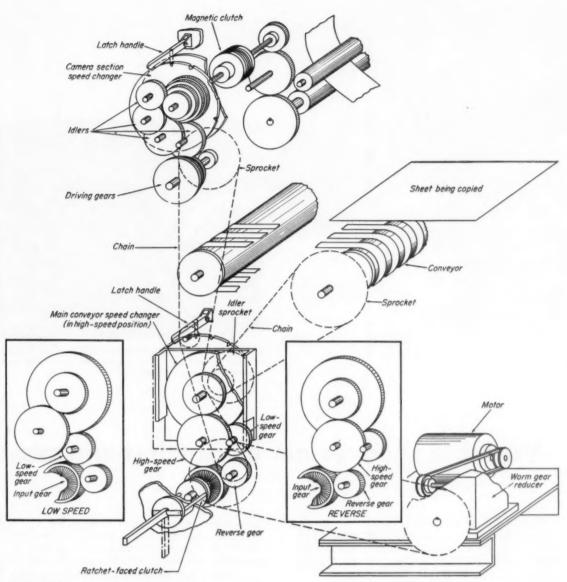
SEVEN DIFFERENT speeds for advancing rolled paper are provided by gear discs that shift by rotation on a new reducing camera. The speed changers adjust travel speed of the sensitized paper to match desired size reduction which changes.

A ½-hp, 1725 rpm motor and worm-type speed reducer with either 35 or 50:1 reduction drive, the main conveyor speed changer through roller chain and ratchet-faced disconnect clutch. The conveyor speed changer provides two speeds forward and two in reverse. Gear shifting is accomplished by rotating the nest on which a high- and low-speed gear and high- and low-speed idlers are mounted. Center of rotation coincides with center of the output gears and shaft.

With the disc positioned as shown, the high speed

idler is in mesh with the forward gear. Rotation of the disc in a clockwise direction disengages the highspeed idler and meshes the low speed idler first with the reverse and then with the forward gear so that in first position it drives in reverse at low speed and when meshed with forward gear drives forward at low speed. Face width of the forward and reverse gears are twice that of either the high- or low-speed idler to permit this.

If the shifting disc is rotated counterclockwise from the position shown, the high-speed idler is disengaged from the forward gear and will engage the reverse gear. Notches in the edge of the disc engage a projection on a latch handle to hold the disc and gears in the selected position. A handwheel is provided for rotating the disc.



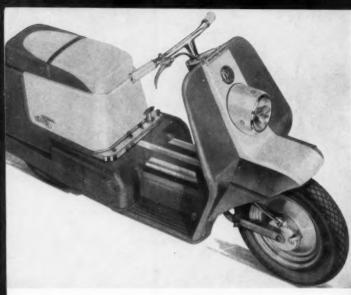
SCHEMATIC of reducing camera drive.

Two sprockets on the output shaft of the main conveyor speed changer and one on the input shaft drive the main conveyor drive roller. The main conveyor runs continuously and carries the drawing or other material to be copied. A sprocket on the input shaft drives the camera section changer.

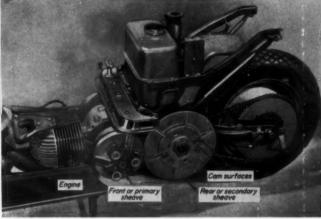
The section speed changer is made up of a fixedcenter four-gear cluster, on the output shaft, four idlers mounted on a shifting disc, and another fourgear cluster on the driven shaft. An idler meshes with each of cluster gears on the output shaft at all times. Ratios are changed by rotating the disc to mesh a different idler with a different gear of the fixedcenter cluster. Reductions in this speed changer are 2:1, 3:1, 3.5:1, and 4:1. The disc is held in correct positions by notches and projections on a handle, and a handwheel is used to rotate the disc.

A solenoid-operated lock prevents the speed changers from being shifted while the camera is operating. Gears in the speed changers are enclosed in gear boxes and run in oil. They are standard 14½ deg involute commercial units. Pinions are steel and larger gears are cast iron with the exception of the forward and reverse drive gears in the main conveyor speed changer. These heavily-loaded gears are SAE 440 steel.

The camera was designed by The C. B. Collins Supply Co., Pittsburgh, Pa. and is marketed by Peerless Photo Products Inc., Shoreham, L. I., N. Y.



IDEAS



FULLY AUTOMATIC TRANSMISSION for the Topper motor scooter uses two centrifugally-controlled and torque responsive variable-pitch sheaves.

Variable sheaves act as clutch, transmission

VARIABLE-PITCH SHEAVES improve speed-torque characteristics of a gasoline engine in a new motor scooter. The sheaves slip to perform clutching and adjust speed and torque as required for different driving conditions.

The front sheave is driven directly from the engine crankshaft. One flange is spring-loaded to separate from the other. Three balls in the housing are held in contact with the movable flange of the sheave.

With the engine turning at 1400 rpm or less, the springs hold the sheave flanges far enough apart so they will not transmit power through the V-belt. When engine speed is more than 1400 rpm, centrifugal force on the balls forces them away from the axis of rotation. An inclined track or ramp in the housing forces the balls to move inward at the same time, and force the movable flange toward the fixed one.

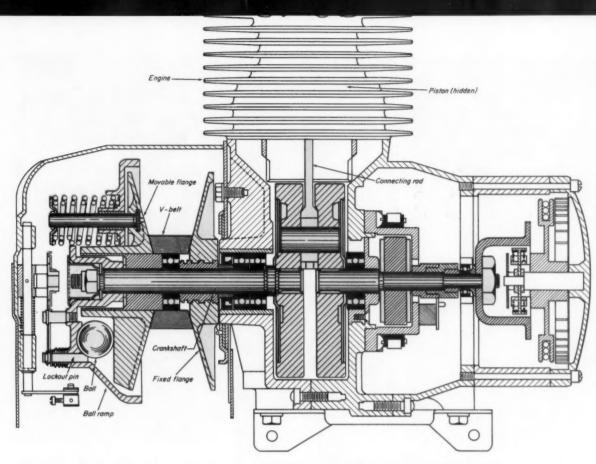
This causes the sheave to engage the V-belt to transmit power. It also increases pitch diameter as speed increases.

At the other end of the belt is another variable-pitch sheave. As pitch diameter of the front sheave increases, pitch diameter of the rear sheave decreases to give reduced ratio as engine speed increases.

When the front sheave first engages the belt, total reduction from engine to drive wheel is 18:1. At 2400 engine rpm, the balls have reached the limit of their travel. This gives minimum reduction ratio of 5.94:1.

Rear sheave construction makes the system torque responsive also. Rollers and cam surfaces between the two halves cause the movable half to rotate relative to the other, as well as move toward or away from it. Relative rotation has the opposite result; that is, any force tending to cause relative rotation of the sheave flanges also causes them to move toward or away from each other with a corresponding change in pitch diameter which also changes the pitch diameter of the front sheave.

To illustrate how this works, suppose resistance to rotation of the drive wheel suddenly increases. This results in an increase in tension on the V-belt. The movable flange then rotates slightly with respect to the fixed flange. Relative rotation moves the flanges closer together to increase pitch diameter. Pitch diameter of the front sheave is proportionally reduced, and a



FRONT SHEAVE is also clutch when fully spread.

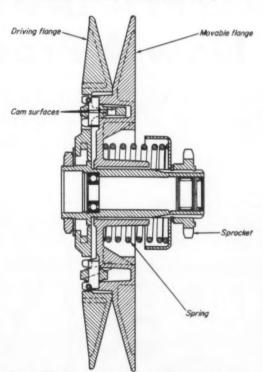
for gas engine

higher reduction ratio supplies the increased torque needed. Drive from the rear sheave to the drive wheel is through chain and sprockets.

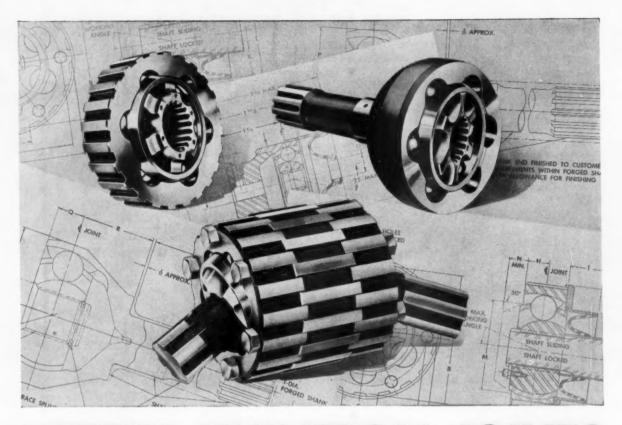
A safety feature of the system prevents accidental engagement of the system when the engine is started. A start-drive lever on the control panel prevents operation of the recoil starter when in the drive position. Moving the lever to the start position frees the starter and moves three pins in the front sheave to block the centrifugal balls in their fully-retracted position to prevent engagement of the belt. If after starting, engine speed is over 1000 rpm, centrifugal force on the balls will hold the locking pins in position even though the lever is moved to the run position.

The single-cylinder, two-cycle, air-cooled engine used on this scooter gives up to 100 miles per gallon of gasoline. The transmission with its automatic variation is an important factor to this fuel economy. Rapid acceleration is also provided by the transmission. The scooter will accelerate from zero to 30 mph in 8 seconds.

Designer and builder of the Topper motor scooter is Harley-Davidson Motor Co., Milwaukee, Wis.



REAR SHEAVE responds to changes in belt tension from change in pitch diameter of front sheave.



RZEPPA UNIVERSAL JOINTS Now A Product Of DANA

New Con-Vel Division To Produce Famed Constant Velocity Universal Joints—With These

Advantages To You:

- INCREASED SPEEDS
- REDUCED DOWN TIME
- LOWER MAINTENANCE COSTS
- HIGHER CAPACITY

Rzeppa universal joints provide perfectly smooth torque all the time, every time, even at angles up to 35°! Rzeppa rules out bounce, chatter, vibration by keeping the hardened steel driving ball bearings in the correct bisecting plane, no matter what the shaft angle may be. The smoother, constant velocity performance of Rzeppa joints naturally increases shaft and bearing life; adds to over-all efficiency and economy of operation.

Rzeppa universal joints are available in a wide variety of sizes, angles, speeds and styles . . . designed for front drives, articulating axles, propeller shafts, and scores of special applications. For information on their many advantages write to-



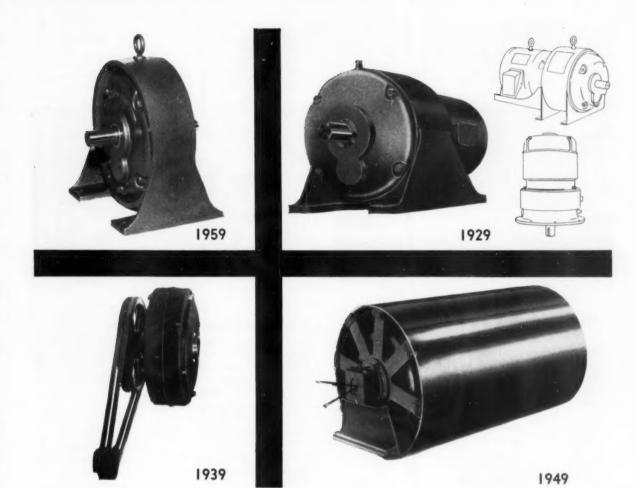
CON-VEL DIVISION

DANA CORPORATION

3901 CHRISTOPHER, DETROIT 11, MICHIGAN

For more information circle No. 35 on Reader Service Card

OCTOBER 1959 / POWER TRANSMISSION DESIGN



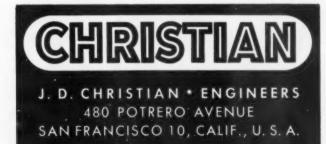
GOOD THINGS
COME
IN SMALL
PACKAGES

... though sometimes "the bigger the better." Either way, we have been designing and building gear "packages" for 35 years. The ones shown here are good examples of some of the units we originated. In order, TORK-FOOT Rite-Lo-Speed Reducer (1/2 to 400 HP), RITE-LO-SPEED Gearmotor (1 to 300 HP), AMERICAN* Reduction Drive (1 to 40 HP), and P.P.T. (1 to 50 HP)—our self-contained, packaged power terminal (motorized head pulley).

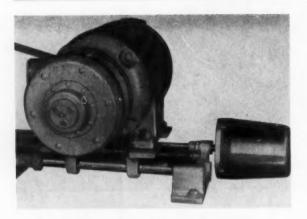
Coming reasonably soon, a new gear package identified now only as Project X-59.

Industry looks to CHRISTIAN to pioneer the best in gear packages. Have you looked lately to see what CHRISTIAN can do for you?

*Mfg'd under license by American Pulley Co.



NEW PRODUCTS

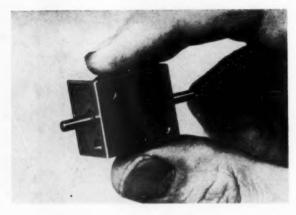


Sliding motor base actuator

Shaftrol Actuator is a high-torque, rotary device for remote and automatic control for variable-speed drives, pumps, reactors, machine tools, etc. It includes a precision potentiometer which is a gear connected to the output shaft through a wide choice of ratios so that from 1/6 to 40 shaft revolutions corresponds to full scale control. A typical unit delivers 200 in.-lbs at 50 rpm for control of the sliding motor base of a variable-pitch sheave drive. Hollow shaft mounting permits manufacturers to offer remote or automatic control as an optional feature without redesign. Shaftrol slips on the control shaft in place of the standard handwheel.

The Jordan Co., Inc., Milwaukee, Wisc.

Circle No. 200 on the Reader Service Card



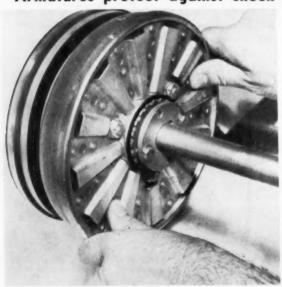
Sub-miniature speed reducer

Ideal for use in business machines, indicators, timers, cameras, chart drives and other o.e.m. low-power devices. 34 different ratios, from 1:1 to 27:1, are available in this model with ratios up to 531441 possible with larger sizes. Reducer handles 16 oz-in. of torque at the low-speed shaft, and speeds to 3600 rpm on the high-speed shaft are reached without excessive wear. Precisely hobbed, smooth-running spur gears, permanently lubricated, are 96 pitch and 20 deg pressure angle. Gears are case-hardened steel for long life and maximum wear resistance. Units mount in any position with shaft heights at either ½ or ½ in., and weigh only $2\frac{1}{4}$ oz.

Metron Instrument Co., Denver, Colo.

Circle No. 201 on the Reader Service Card

Armatures protect against shock and vibration



New line of spline drive armatures for use on integral horsepower electric clutch-coupling and brake applications where shock-loading or vibration-loading are problems. Armature assemblies are now available in 8, 10, 12 and 15 in. diameters, and can also be used on many special clutch applications where the equipment builder or user furnishes the male splined hub. No mounting adjustment is necessary. The armature is pressed tight against the magnet face at the completion of mounting and on release the airgap is set automatically by the autogap spring. Automatic compensation for magnet and armature wear is provided by the spring. It fits over the splined hub and moves with the armature to compensate for wear, but always maintains a 1/32-in. gap when unit is disengaged. When the total bearing surface of the armature is compared to that of three or four conventional drive pins, the superior ability in withstanding shock loads and vibration is apparent.

Warner Electric Brake & Clutch Co., Beloit, Wisc.

Circle No. 202 on the Reader Service Card

FOR QUICK ACTION . . .

for more information on any new product items on these pages, use Reader Service Card opposite page 64. Just circle number or numbers you want, fill out Card and drop it in the mail. We'll do the rest.

Geneva drives

Standard drives with 3 to 24 indexing stations for shaft center distances from 3 to 6 in., ½-in. increments. Wide variety of hub and bore diameters. Special styles increase applica-



tion in high-speed automation where accurate indexing, positive locking are requisites.

Genevamatic Engineering Corp., Tampa, Fla.

Circle number 203 on reader service card

Dial speed control

New model Servotran gives infinitely variable speed drive with vernier dial for precision speed setting. With sole-noid control switch in neutral, you can set the ten-turn dial so the output shaft runs at any speed from zero to full. Then just move switch to forward or reverse position. Control is available with motors to ½ hp, 115 v,



60 cycle. Other model variations for sub-miniature operation.

Humphrey, Inc., Humphrey Products Div., San Diego, Calif.

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Continued on next page

economy a wide selection! ...pluscullman roller chains ...

For replacement or new equipment, Cullman Roller Chains are available in all standard pitches in single and multiple widths. Also included are conveyor, extended pitch, heavy-duty, as well as non-corrosive and heat resisting chain, with or without standard or special attachments.

Cullman Roller Chain is economical because you can buy any length needed for assembly on your equipment. Also available in standard lengths on reels or boxed, clearly marked for identification and easy storage.

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Representatives and Distributors in all Principal Cities
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POWER TRANSMISSION DESIGN / OCTOBER 1959



Perfection Worm Gear Speed Reducers by American Stock Gear are available in 9 complete series with ratios ranging from 5 to 1 to 60 to 1 for input revolutions ranging from 300 per minute to 1800 per minute. Speed Reducers are furnished in horizontal right angle drive with worm in either top or bottom position and are also furnished in vertical right angle drive. Integral worm and shaft is made of selected quality, case hardened alloy steel. Threads are precision ground and accurately mated with worm gear. Shafts are mounted in Timken antifriction roller bearings. Heavy rigid cast-iron housings . . . easily accessible oil filling level and drain plugs are provided for oil reservoir. Oil seals are of selected cirvis leather which assures maximum sealing effect. Available through your nearest American Stock Gear Distributor.

5 to 1 to 60 to 1

Write for new 16 page catalog covering the complete PERFECTION Speed Reducer line.

AMERICAN STOCK GEAR DIVISION

PERFECTION GEAR COMPANY

HARVEY, ILLINOIS, U.S.A.

FOR QUICK ACTION . . .

for more information on any new product items on these pages, use Reader Service Card opposite page 64. Just circle number or numbers you want, fill out Card and drop it in the mail. We'll do the rest.

Automatic truck clutch

New Presto-matic transmission system eliminates clutch pedal in heavyduty trucks with no sacrifice of fuel economy. Control button on top the gearshift lever engages or disengages the clutch at slight touch. Smooth engagement from standing start is automatic, due to a sensing mechanism that synchronizes clutch engagement with engine speed. Full engagement is at 1500 rpm, full disengagement at 500 rpm, but clutch can handle full engine torque at about 1000 rpm.

Dana Corp., Toledo, Ohio. Circle number 205 on reader service card

Adhesive-bonded parts

Assembling metal parts such as small pinion gears to rotor shafts by adhesive bonding is claimed often to be better than fusion methods of metal joining. Adhesives do not need the high heat used in brazing which often distorts the part or affects its heat-treated strength. Inspection need not be so rigorous. One company assembles timing gears by adhesivebonding small pinion gears to rotor shafts. These timing gears are used in synchronous motors which require small gear trains of extreme accuracy. Using EC-1386 adhesive, no



bond failures occurred during laboratory life testing at high and low temperatures and at high humidity.

Minnesota Mining and Mfg. Co., St. Paul, Minn.

Circle number 206 on reader service card

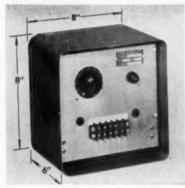
Magnetic brake

Solenoid-operated brake band and drum-type brake may be mounted on any standard NEMA frame motor with standard single shaft extension for compactness and economy. Horizontal or vertical position for continuous or intermittent duty with any acmotor. Torque ratings from 1½ to 9 lb-ft, continuous operation.

Able M/g. Co., River Edge, N. J. Circle number 207 on reader service card

Selenium rectifiers

Each model is supplied with its own enclosure, fuse holder with fuse and lead wires. Some give variable d-c output, come with rheostat included. Cartridge type fuse protects against



short circuiting. Ratings from 40 to 100 watts, at 100 v d-c output. 5 fixed-output, 3 variable-output models. Suitable units for 115/60, 550/60 or 220/440/60 a-c input.

Stearns Electric Corp., Milwaukee,

Circle number 208 on reader service card

Belt dressing

Spragrip is a new pressurized belt dressing packaged in an aerosol can. It treats moving or hard-to-reach belts or sheaves with complete safety to the operator. Synthetic-base dressing holds power longer, does not harden.

A. W. Chesterton Co., Everett, Mass.

Circle number 209 on reader service card

Continued on next page

A do the work of 6

DICKROPE
"Q D"
V-BELT DRIVES

deliver 40% more H.P. per belt!

MANY SAVINGS... Sheaves can be smaller, lighter, the drive more compact, and belting costs sharply reduced by the use of today's Dickrope "QD" V-Belt Drives. Reduced initial costs... increased belt life... savings on maintenance and space.

"TEMPERED" CONSTRUCTION...a pacesetting advance that increases belt h.p. rating 40%, minimizes stretch, increases resistance to abrasion and shock, adds flexibility. Smooth vibration-free operation is assured by freedom from surface irregularities and by the Dick "QD" sheave... precision made, tight fitting, easily installed and removed.

Prompt, off-the-shelf delivery of belting and sheaves to meet practically every drive requirement.

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Without charge or obligation to me, please send a copy of your new "Engineering Manual — Dickrope 'QD' V-Belt Drives."

Name.

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- Fractional to 400 HP.
- Ratios to 10,000 to 1

A Size and Type for every Speed Reduction Need

Choose the speed reducer you need from Abart's complete line. Rugged, compact units are easy to install on new or old equipment—assure lower operating and maintenance costs. Worm, spur and

combination gear—single or double reduction—with any desired shaft arrangement. Call your local Abart distributor today, or

write direct for handy pocket-size speed reducer catalog.





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No Stocks • Any Material • Any Quantity

All Abart Gears are precision cut to exact specifications. Spur, spiral, bevel, helical, internal worm, rack, sprocket types— ½ to 96 D.P., ¼" to 18" P.D. Request latest Abart Gear Bulletin. Send b/p and specs or sample for prompt estimate.

ABART GEAR & MACHINE CO.

4833 West 16th Street

Chicago 50, Illinois

FAST'S Model B Coupling



reduces downtime and upkeep for light-to-medium drives!

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3½" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free per-

formance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 5910 Scott Street, Baltimore 3, Maryland.

Engineered Products
Sold with Service



FAST'S Couplings

For more information circle No. 16 on Reader Service Card.

CONTINUED from preceding page

Stock sprocket service

Finished bore stock sprocket assembly, called Selecta-Bore, gives improved choice possibilities to roller chain sprocket users. Sprockets give over 600 possible pitch, teeth and bore size combinations while keeping inventory small. Interchangeable plates and hubs do the trick. Assembled ready for installation, complete with standard keyway and setscrew.

Whitney Chain Co., Hartford, Conn.

Circle number 210 on reader service card

Specialized lubricant

No-Gall is anti-friction, anti-seize compound for metalworking, marine and general industrial applications. It serves as a superior drawing and forming compound, protects machine slides and lathe dead centers from



excessive frictional wear, makes a moisture-resistant gasket seal and protects against seizing and galling in press fitting operations, keyway lubrication and other high pressure installations. For brush or paddle use.

Keystone Lubricating Co., Philadelphia, Pa.

Circle number 211 on reader service card

Improved V-belts

Royal V-belts increase hp ratings 40 percent over company's older line, and are said to eliminate need for premium belting line. Cord-treatment machine normalizes strands and impregnates latex into each fibre, rather than surface-coating them. Thus fewer belts per load requirement and narrower sheaves are possible.

U. S. Rubber Co., New York, N. Y.

Circle number 212 on reader service card

Continued on page 44

NEW! CROWN GEAR UNITS

NOW 17 Models for Right Angle Power Transfer

Simplify your right angle power transmission problems by using a Crown Packaged Unit. There's a stock unit among Crown's new line which will fit practically any application. Designed for rugged industrial use, these compact units are completely enclosed, and will provide years of reliable service.

By using a Crown "package" you eliminate much detailed design work, enabling you to devote more effort to your overall design problem. They're the ideal solution to all types of right angle power transfer, and are especially adaptable to confined areas.

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a subsidiary of Harrington & Richardson, Inc.
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- Light, compact, completely enclosed 356 Aluminum alloy housing—designed for maximum strength and heat dissipation.
- · Non-magnetic, Stainless Steel Shafts.
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SPECIAL CROWN GEAR UNITS MANUFACTURED TO YOUR SPECIFICATIONS.

- 1. Non-Standard Housing Material.
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Save \$ \$ \$

ATLAS UNIVERSAL JOINTS

Balanced to operate without vibration at all speeds. Short, stubby jaws give maximum resistance to spread. Larger diameter joints fitted with big grease reservoir. Standard alloy steel joints in fifteen sizes for all requirements. Also made in Bronze, Monel and other special metals.

Universal Slip Shafts a specialty.

WRITE for illustrated catalog giving data and specifications.

WEST COAST REPRESENTATIVES
LINK-BELT CO.



Circle No. 13 on Reader Service Card.

CONTINUED from page 42

Acceleration switch

High-performance switch first produced for missile-launching computers is applicable to many operations. Single-pole, double-throw, built-in relay design makes possible a wide



range of dynamic performance characteristics, different damping ratios, time constants and natural frequencies. Excellent accuracy, light weight (under 4 oz), low cost.

Humphrey, Inc., San Diego, Calif.

Circle number 213 on reader service card

Reversible transmission

Hydraulic transmission, 1-½ hp, gives infinitely variable speed from 0 to 350 rpm in either direction. Forward and reverse speeds may be set identical or different. Integral torque multiplier for high torque applications. Motor is available in either



single or three-phase 60 cycle. For heavy-duty applications where production efficiency is paramount, such as conveyors, printing presses, textile and paper machines, etc.

Roberts Mfg. Co., Chicago, Ill.

Circle number 214 on reader service card

Continued on page 55

NEW 2 1/4 HP
ANGLGEAR
HELPS SIMPLIFY
YOUR 90° DRIVE
PROBLEMS



Hardened bevel gears and antifriction bearings insure smooth, trouble-free operation. Completely enclosed, permanently lubricated ANGLgear requires little or no maintenance.

Addition of the new 2½ hp size to the ANGLgear line makes it easier than ever to solve your 90° power takeoff problems with this standardized right-angle drive. You can now specify ANGLgear in any one of 16 different stock models, offering power ratings from ½ to 5 hp, with choice of 1:1 or 2:1 gearing and 2 or 3-way shafting.

Compact, high capacity ANGLgear offers you several distinct advantages over V-belts or chains and sprockets. Featuring 5-way mounting, it is easier to design into your power transmission systems. Incorporating positive bevel gear drive, it eliminates slippage and backlash problems. Completely enclosed, it presents no safety hazards. Permanently lubricated, it requires virtually no maintenance. And not the least important, ANGLgear invariably costs less than other types of 90° drives.

See our literature in Sweet's Product Design File or contact your local distributor.



CORPORATION

HILLSIDE 5, NEW JERSEY

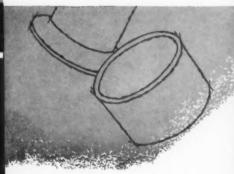
Circle No. 2 on Reader Service Card.

OCTOBER 1959 / POWER TRANSMISSION DESIGN

BEARINGS DESIGN APPLICATION

REGULAR MONTHLY
SECTION OF IDEAS
AND DEVELOPMENTS

POWER
TRANSMISSION
DESIGN



October 1959

Smooth as silk . . . the shaft rotates

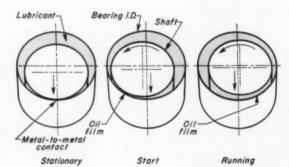
in a film of oil . . .

A sleeve bearing is a

Oil separates the metal surfaces

The shaft in a sleeve bearing is suspended in a film of oil when rotating. There is no metal-to-metal contact if a lubricant is present. Thus, the critical feature of a sleeve bearing is the necessity for lubrication.

A sleeve bearing is not a friction bearing but a highly efficient anti-friction bearing. When sufficient lubrication is not present, and the rotating shaft engages the bearing, operation will continue nonetheless because the shaft is always harder than the bearing



and bearing metal just rubs away.

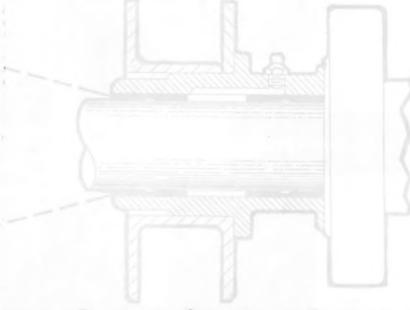
The three drawings show three conditions of operation. At rest, the shaft does rest metal-to-metal against the bearing. At starting, friction and heat immediately suck in lubricant from nearby areas and emulsify the shaft. When running, the shaft rotates totally separated by an oil film without metal contact.

A sleeve bearing is ideal where an abundance of lubrication is always available. For this reason, sleeve bearings are used in automobile engines and similar applications and provide long life at low cost.

There are exceptions, however, where bearings can run dry or with partial lubrication and still have long life. Heat is then a major factor and shaft clearances must not be lost.

A sintered bearing provides constant lubrication by holding approximately 20 percent lubricant by volume within its pores. During operation, the lubricant is withdrawn from the pores by capillary attraction into the working area which floats the shaft. The lubricant may be solid, liquid or gaseous such as graphite, oil or grease, or air.

For extra free reprints of this 9-page article, circle number 300 on Reader Service Card.



good anti-friction bearing

Bearing or bushing?

Different authorities classify bearings and bushings differently.

Some call it a bearing if it operates at higher speeds, and a bushing if it operates at lower speeds.

Others call it a bearing if it carries appreciable load, and a bushing if it carries virtually no load—thus, the crankshaft bearing and the camshaft bushing.

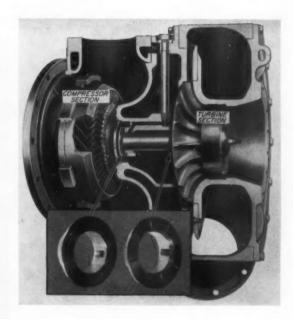
Another will call it a bearing if it exists in two half pieces or shells, and a bushing if it is continuously round and in one piece.

Another will call it a bearing if a rotating member bears on or in it, and a bushing if it acts as a spacer without rotary bearing surfaces.

Te word bushing is an outgrowth of the 'bush' that was used to slip into oversize holes to make things fit.

The word bearing is gradually overtaking the word bushing and may some day replace it entirely.

DIESEL ENGINE TURBOCHARGER has two precision steel-backed copper-lead lined sleeve bearings. Speeds are in excess of 150 surface fps at the bearing surfaces.





SELF-ALIGNING BUSHING



STEEL-BACKED SPLIT BUSHING



BOWED THRUST BEARING



OILLESS PLASTIC BEARING



OILLESS WOOD BEARING



STEEL-BACKED BEARING, BOTH SIDES



TYPICAL BEARINGS AND BUSHINGS

STRAIGHT SHELL THIN-WALL BEARING



THRUST BEARING



SINTERED BEARINGS, ALL TYPES



BEARING CARTRIDGE WITH RUBBER LINER



NYLON BEARING LINERS



STRAP-TYPE PILLOW BLOCK





STEEL-BACKED





SPHERICAL BALL SOCKET BUSHING



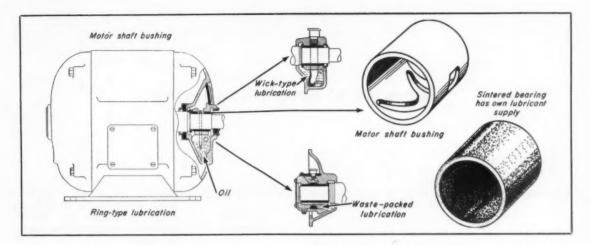
PLAIN BUSHINGS



THRUST BEARING



GRAPHITED BUSHING



How much lubricant

A sleeve bearing is a lifetime component if properly lubricated. When rotating, the shaft does not touch bearing metal and slides smoothly inside a film of oil. These are not ideal, but standard conditions.

Too much lubrication—such as superfluous flow of oil—is alright but beyond necessity. The correct amount needed can be calculated for various speeds, loads and temperatures.

No lubrication at all lets the shaft wear away bearing metal. This is often satisfactory when load and speed are not high enough to cause excessive heat.

Nominal or boundary lubrication exists when only partial lubrication is present. Partial metal-to-metal contact is sometimes permissible and is the way some applications are designed.

The proper amount of oil or grease is that amount

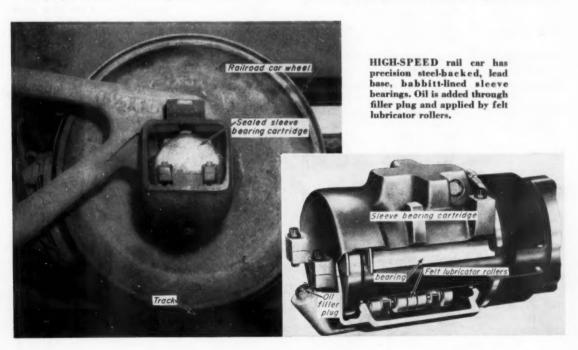
that the bearing itself needs to keep the shaft lubricated and to carry away excessive heat.

Oil Grooves

Oil grooves are hollowed-out recesses in bearing walls for retaining lubricant next to rotating shafts and permitting through-passage. There are many different designs, ranging from straight, circular, crisscross, X, spiral and combinations of each.

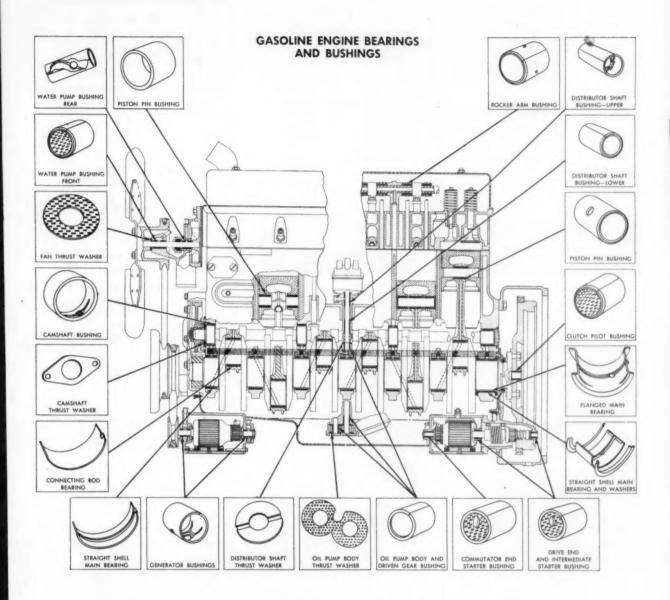
Graphite and other solid lubricants are often impregnated into the grooves to provide a fixed and constant lubricant supply. Graphite does not crack, chip or cake off in the grooves and provides continuous lubrication for life of the bearing.

Lubrication is the most important single factor for continuous operation of sleeve bearings.

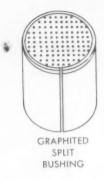


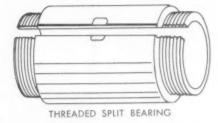
Glossary of descriptive terms

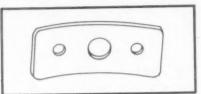
Adhesion Lead base	Property of lubricant that causes clinging to bearing surface. White metal alloy in which	Eccentric bearing	wall thickness is at crown and tapers few ten thou- sandths less toward the part-
	chief constituent is lead. Popular alloys are lead, anti- mony, tin and arsenic.	Fatigue	ing faces. Deterioration of bearing metal under excessive loads or
Babbitt	Tin base alloys with 85% to 90% tin.	F1 11 .	prolonged operation.
Backing	Steel shell on which bearing lining is adhered.	Flanged bearing	With vertical discs at ends (flanges) that ride against vertical machined face for
Bearing back	Outside area of bearing that seats against housing bore.		carrying thrust loads.
Bearing cap	Removable half of saddle	Housing bore	Machined surface into which bearing is installed.
Bearing height	that holds bearing in place. neight Vertical distance of assem-	Journal	Part of shaft that revolves in bearing.
	bled bearing, theoretically one-half high limit of hous- ing bore.	Micro bearing	Insert type bearing having exteremely thin overlay.
Bearing length	Overall distance of bearing end to end.	Oil clearance	Difference between bearing ID and diameter of journal.
Bearing lining	Alloy adhered to back form- ing surface area.	Oil film	Thin layer of oil that sepa- rates journal and bearing
Bearing, lower	Bearing half shell for assem- bly in bearing cap.		preventing metal-to-metal contact during operation.
Bearing saddle bore	Seat into which bearing is assembled.	Oil groove	Canal in surface of bearing to spread oil or to permit
Bearing shell	One of pair of insert bear- ings.	1	transfer of oil.
Bearing wall thickness	Thickness of bearing shell; one-half difference between	Oil hole	Hole in bearing wall to allow oil passage.
	OD and ID.	Oil Seal	Device to prevent oil seepage.
Bronze	Alloy of high copper and other metals such as lead, tin, zinc, etc.	Oil Starvation	Deprived of adequate lubrication.
Cadmium alloy	Alloy containing high per- centage of cadmium.	Out-of-round	ID or OD having varying diameters measured at dif-
Copper alloy	Bearing material commonly referred to as red metal.	Overload	ferent points.
Copper-lead	Metallic lining for heavy	Overload	Bearing load in excess of de- sign load
Crush	duty applications. Press fit allowance to hold two bearing halves securely	Parting edge	Edge formed where inside or outside surface joins parting face.
	in housing bore. In bearing half, amount of circumference in excess of half circle.	Parting face	Surface in contact with other bearing half when assembled.



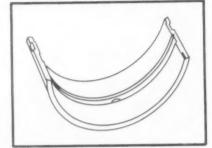
Parting line Theoretical line formed by Flanged bearing to carry Thrust bearing parting faces. axial loads and control end play. Precision bearings Manufactured to close tolerances. No machining neces-Tri-metal bearing Precision bearing composed sary to obtain oil clearance. of three layers-steel back, Tight fit, requiring pressure for proper assembly; used intermediate layer, and thin Press fit coating. where parts remain station-ary with relation to each ID or OD less than standard Undersize other. Internal fraction due to mo-Viscosity Resizable bearing Can be resized down to standlecular oil cohesion. ard. Wear Gradual change in dimension Spread Excess of diameter at the outside parting edges over housing bore. due to loss of surface metal. Wear-in Slight surface adjustment Quantity of oil which escapes at end of bearings. made by mating parts to compensate for discrepancies. Throw-off







RING GEAR THRUST PLATE



STRAIGHT HEAVY-WALL BEARING

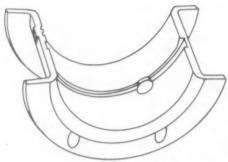
TYPICAL BEARINGS AND BUSHINGS



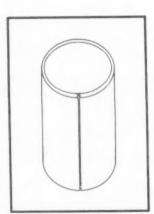
BALL-INDENTED SPLIT BUSHING



FLANGED PILLOW BLOCK



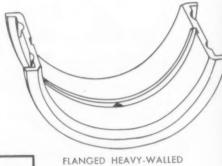
DOUBLE-FLANGED THIN-WALL BEARING



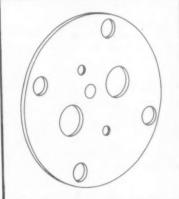
PLAIN SPLIT BUSHING



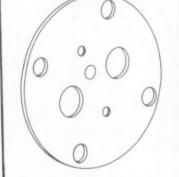
FLANGED BEARING WITH O-D SPLINES



BEARING



PITMAN ARM OR TIE ROD BUSHING



WEAR PLATE

PV Factor

PV factor is a value accepted throughout industry to specify load carrying capacity of sleeve bearings. It is a product of load times speed.

PV factor can be calculated as follows

$$FV = \frac{W}{Ld} \times \frac{\pi dn}{12} = \frac{\pi Wn}{12L}$$
....(1)

where

L = bearing length, in.

P = applied load on projected bearing area, psi

V = surface velocity of shaft, ft/min

W = bearing load, lb

d = bearing ID, in.

n = shaft speed, rpm

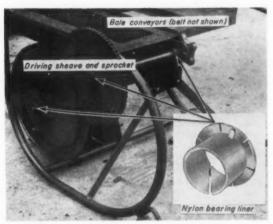
Each type of bearing and bushing has a PV factor. Each manufacturer lists factors in his catalog. You can figure your conditions and check them against this formula before selecting bearings you want. Charts and graphs are included in most handbooks to show you top limits at a glance.

PV factors for sintered bronze are usually about 50,000 and for sintered iron, 35,000. They are higher and lower for other types of bearings and bushings.

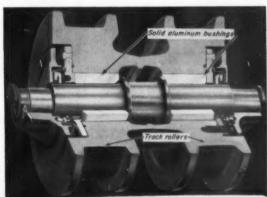
You Select Size

It is your prerogative to specify sleeve bearings from manufacturers to fit your design. Different from rolling-element bearings, sleeve bearings can be specified to fit space left over after shaft and journal sizes are established.

ROLLERS ON HEAVY crawler tractor have solid aluminum bushings to carry load. Oil eliminates metal-to-metal contact of shafts and bushings.



SHAFTS, SHEAVES and sprockets on bale conveyor are supported by snap-in Nylon bearing liners.





Sleeve Bearing Manufacturers

Allied Products Corporation
Powdered Metal Parts Division
Aluminum Company of America
American Bearing Corporation
American Brake Shoe Company
American Crucible Products
Company
American Powdered Metals, Inc.
American Non-Gran Bronze
Company
American Sinteel Corporation
Subsidiary of Mueller Brass
Company
Ampeo Metal, Inc.
Anagra, Inc.
Anagra, Inc.
Anchor Packing Company
Arguto Oil-less Bearing Co.
Arrow Sintered Products Company
Asco Sintered Corporation
Allas Brass Foundry

The Bassick Company
Bearium Metals Corporation
Bohn Aluminum & Brass
Corporation
Boston Gear Works
Bound Brook Oil-less Bearing
Company
Brockway Pressed Metals, Inc.
Bronze Bearings, Inc.
Buckeye Brass & Manufacturing
Company
Bunting Brass & Bronze Company
Bushings, Inc.

Carbon City Products Company, Inc.
Carbone Corporation
Ceromet, Inc.
Chicago Powdered Metal Products
Company
Chrysler Corporation
Amplex Division
Cleveland Graphite Bronze Division
Clevite Corporation
Colts Manufacturing Company
Columbiana Engineering Company
Companeted Metals Corporation
Continental Diamond Fibre
Company
Continental Gin Company
Continental Rubber Works

Detroit Aluminum & Brass Corp. Dixon Sintaloy, Inc. Dodge Manufacturing Corporation Doons-Smith Brass & Copper Company

Eaton Manufacturing Company
Powdered Metals Division
Elco Sintered Alloys Company, Inc.
Engineered Plastics, Inc.
American Sinterings Division
Erie Bronse Company
Everard Tap & Die Corporation
Ex-Cell-O Corporation
Exline Engine Works
Federal-Mogul Division
Federal-Mogul-Bower
Bearings, Inc.

Ferro Powdered Metals, Inc. Ford Motor Company Freeway Washer & Stamping Company

Gatke Corporation
General Sintering Corporation
B. F. Goodrich Industrial Products
Company
Graphite Metallizing Corporation
Green Bay Foundry & Machine
Works
Greene, Tweed & Company
Gries Reproducer Corporation
Griffin Wheel Company

Haller, Inc. Halsmith Corp. Home Rubber Company

Indar Corporation
Industrial Tectonics, Inc.
International Powder Metallurgy
Company, Inc.
International Powder Metallurgy,
Inc.
Rocky Mountain Metals Division,
Inc.

Johnson Bronze Company Jeffrey Manufacturing Company

Keystone Carbon Company Kingsbury Machine Works, Inc. Kwikset Powdered Metal Products

Lau Blower Company Link Belt Company

Magnolia Metal Company
McNally Pittsburgh Manufacturing
Corporation
McQuay-Norris Manufacturing
Company
Merriman Brothers, Inc.
Mesta Machine Company
Metal Ceramics Powdered Metal
Products
Metzgar Conveyor Company
Mica Insulator Company
Mocasin Bushing Company
Moraine Products Division
General Motors Corp.
Morganite, Inc.
Morrison Products Inc.
Mueller Brass Company

National Lead Company National Molded Products, Inc. National Vulcanized Fibre Company Nolu Oil-less Bearing Company Norwalk Powdered Metals, Inc. O & S Bearing & Manufacturing Company

Pacific Sintered Metals Company Paramount Oilless Bearing Company, Inc. Parket White Metal Company
Perth Metal Industries, Ltd.
Picco, Inc.
Pittsburgh Brass Manufacturing
Company
Pittsburgh Coal Washer Company
Polymer Corporation of
Pennsylvania
Powder Metal Products, Inc.
Powdercraft Corporation
Precision Metal Products Company
Presmet Corporation (The)
Pure Carbon Company, Inc.

R & J Dick, Inc. Randall Graphite Bearings, Inc. Raybestos-Manhattan, Inc. Reese Metal Products Corporation The Richardson Company Roberts Toledo Rubber Company

Saginaw Bearing Co.
St. Marys Carbon Company
Sandusky Foundry & Machine
Company
Sandy Hill Iron & Brass Works
W. S. Shamban & Company
Shenango-Penn Mold Company
Shoop Bronze Company
Sintered Metals, Inc.
S. Morgan Smith Company
Spadone-Alfa Corporation
Spadone-Mfa Corporation
Spadone Machine Co., Inc.
Spaulding Fibre Company, Inc.
Southwest Products Company
Stackpole Carbon Company
Standard Automation Products
Standard Carbon Company
Steering Engineering Corporation
Superior Carbon Products, Inc.
Symmoo, Inc.
Synthane Corporation

Taylor Fibre Company Thomson Industries, Inc. Tilton Machine & Tool Company

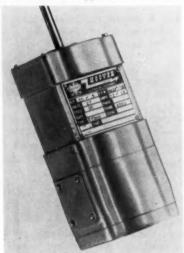
Union Carbide Corporation
National Carbon Company
Division
Union Diesel Engine Company
United States Gasket Company
Plastics Division—The Garlock
Packing Company
United States Graphite Company
Division of the Wickes
Corporation

Wakefield Bearing Corporation
Waterloo Wood Bearing Company,
Inc.
Waukesha Bearings
Western Sintering Co.
Wilmington Fibre Specialty
Company
T. B. Woods Son's Company
The Yale & Towne Manufacturing
Company
Powdered Metal Product Division

CONTINUED from page 44

D-c motor

Light-weight, rectangular-frame motor gives greater power output with less space. Adaptable to a wide range of aircraft, missile, ordnance, marine and industrial applications such as



pumps, compressors, gear boxes, actuators, etc. Model C-1360 gives .33 hp at 8400 rpm, .50 hp at 7700 rpm, continuous duty, 28 v d-c. Other models using this frame from 1/5 to 1 hp with speed range to 30,000 rpm. Totally enclosed, explosion proof.

Hoover Electric Co., Columbus, Ohio.

Circle number 215 on reader service card

Bellows coupling

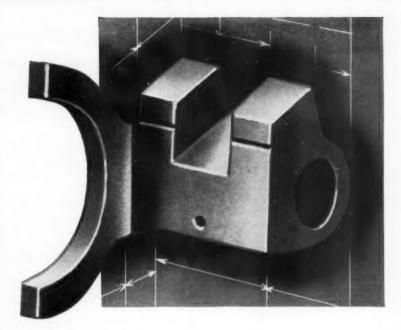
Type T9 adjustable bellows coupling is available for off-the-shelf delivery. Design allows precision adjustment on sensitive shafts of servo motors, resolvers and synchros. It is also designed for 360 deg continual rotation



and adjustment. Four basic shaft sizes, can be applied on pin and clamp type hubs. Made entirely of stainless steel.

PIC Design Corp., East Rockaway, N. Y.

Circle number 216 on reader service card



this new part brings outstanding cost reductions...

The photograph is of a shifter fork used in the transmission of a very popular garden tractor in volume production.

Clearly evident is the economy that can be achieved by powder metallurgy over other previously used methods. The elimination of practically all machine work effects striking cost reduction.

Made of pure powdered iron, infiltrated with copper to give added strength and ductility, this part is intended to meet the higher physical properties of wrought metals.

The user of this part naturally presented his problem to Bunting first.

For the unusual, as well as the usual, in bearings, bushings, bars and special parts of cast bronze, sintered metals, or Alcoa aluminum, see Bunting first.

BUNTING SALES ENGINEERS in the field and a fully staffed Product Engineering Department are at your command without cost or obligation for research or aiding in specification of bearings or parts made of cast bronze or sintered metals for special or unusual applications.

... ask or write for your copy of ...

Bunting's "Engineering Handbook on Powder Metallurgy" and Catalog No. 58 listing 2227 sizes of completely finished cast bronze and sintered oil-filled bronze bearings available from stock.

The Bunting Brass and Bronze Company Toledo 1, Ohio EVergreen 2-3451

Bunting

BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE OR SINTERED METALS. ALCOA® ALUMINUM BARS

For more information circle No. 4 on Reader Service Card.



"MAYBE I BETTER GIVE



YOU CAN ALWAYS BE SURE
OF ACCURACY WHEN YOU USE

Bond STOCK GEARS AND PINIONS

There's no risk of getting a gear that won't quite mesh or is too small in the bore—not when you use Bond Stock Gears. You order replacements by using a simple symbol—there is no long list of dimensions which might be mis-read by a machinist making a gear to order. When you order Bond Stock Gears, we simply take the exact item you specify out of stock and deliver it to you without delay.

You can avoid lost production time and wasted manhours by standardizing on Bond Stock Gears and Pinions. The full line is listed in Bond Catalog No.100 —write for your copy today.

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DISTRIBUTORS IN PRINCIPAL CITIES

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or write to

CHARLES BOND COMPANY 617-23 Arch Street, Philadelphia 6, Pa.



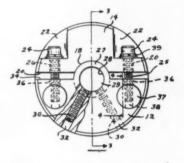
For more information circle No. 3 on Reader Service Card.

PATENTS continued from page 15

Adjustable locking coupling

U. S. Patent 2,867,461; Stanley Kahn, West Newton, and Nesbit L. Duncan, Belmont, Mass., assignors to the United States of America as represented by the Secretary of the Air Force.

Feature of this coupling is integral means for adjusting phase relationship between the two inline shafts which it joins. A pair of bolts normal to the shaft



axis and on opposite sides of the shaft extend through one member of the coupling into threaded plugs pivoted in axial holes in the other member of the coupling. By tightening one bolt while loosening the other, in-phase alignment is gotten by rotating one member relative to the other.

HORTON VARIABLE SPEED CLUTCH PULLEYS



for

soft starts

easy acceleration

> inching drives

Use a Horton Variable Speed Clutch Pulley with an A. C. electric motor and get the same performance as a variable speed drive at a FRACTION OF THE COST.

write for bulletin M-I

HORTON Manufacturing Co., Inc.

Minneapolis 14, Minnesota

For more information circle No. 15 on Reader Service Card.
OCTOBER 1959 / POWER TRANSMISSION DESIGN

LITERATURE on drives and components

Compact motors

Bulletin SP-1 gives details on Space-Saver motors, ratings from $\frac{1}{2}$ to 10 hp, standard drip-proof and totally enclosed models.

Peerless Electric Co., Warren, Ohio.
Circle number 21 on reader service card

Stock gears

Catalog 100 gives full line of stock gears and pinions for quick replacement and accuracy.

Charles Bond Co., Philadelphia, Pa.

Circle number 3 on reader service card

Deep-groove bearings

Standard-width, in extra-light, light, medium and heavy series. Open or with shields or contact seals, with or without snap ring. Dimensions, loads, application data in 12-page Bulletin 110.

Hoover Ball and Bearing Co., Ann Arbor, Mich.

Circle number 40 on reader service card

Compact V-belt

Reduced size, decreased costs are features of Super HC V-belt drives. Reduction of over-all drive costs up to 20 percent is claimed. Handbook is entitled "The Modern Way to Design V-Belt Drives."

Gates Rubber Co., Denver, Colo.

Circle number 11 on reader service card

Slow-speed gearmotor

Technical data sheet on enclosed, helical-geared motors for small appliances and other low-power uses. Speeds from 6 rpm, torque ratings to 40 in-lb. Optional features include brake, clutch and fan.

Brevel Products Corp., New York, N. Y.

Circle number 41 on reader service card

Flexible coupling

Rubber-cushioned sleeve bearing and dihedral gear types giving full hp transmission. Important economies in original equipment or replacement.

Ajax Flexible Coupling Co., Inc., Westfield, N. Y.

Circle number 30 on reader service card

Gear manual

Engineering data on basic design requirements such as ratings, selections, center distances, bearing loads, mounting methods, etc. Company's line of Spiroid gears, a skew-axis system for medium to high reduction ratios, is explained. 36 pages, illustrated.

Spiroid Div., Illinois Tool Works, Chicago, Ill.

Circle number 42 on reader service card

Couplings

Malleable split taper bushings interchange in company's couplings, sheaves, sprockets, pulleys and assembles with good shaft grip. Fixed-bore styles also. Catalog C210.

Browning Mfg. Co., Maysville, Ky. Circle number 31 on reader service card

Chain drive handbook

Installation, operation and maintenance procedures for chain drives and chain conveyors. Bulletin 59126, pocket-size, illustrated.

Chain Belt Co., Milwaukee, Wisc. Circle number 43 on reader service card

Universal joints

Rzeppa line gives smooth torque even at angles up to 35 deg. Wide variety of sizes, angles, speed and styles, for front drives, articulating axles, propeller shafts and special applications.

Con-Vel Div., Dana Corp., Detroit,

Circle number 35 on reader service card

FOR QUICK ACTION ...

for obtaining useful literature items on these pages, use the Reader Service Card opposite page 64. Just circle the number or numbers you want, fill out the Card and drop it in the mail. We'll do the rest.

Double row bearings

Open, shielded and snap ring types are fully described in bulletin 111. Dimensions and load specifications, application considerations outlined with respect to uses requiring heavy radial loads, moderate thrust, shaft rigidity and limited housing space. Outer diameters from 1.1811 to 9.4488 in.

Hoover Ball and Bearing Co., Ann Arbor, Mich.

Circle number 44 on reader service card

Gear motors and reducers

Ritespeed models, fractional to 80 hp, ratios to 82:1. Floor, ceiling, wall or vertical mounting styles.

Crofts U. S. A., Inc., Chicago, Ill.

Motors described

Bulletin 2650, eight pages, shows complete line of ac and dc motors, special motors, gearmotors and adjustable-speed drive units. Twenty basic types, including ranges from 3/4 to 2000 hp, are summarized, typical applications pictured.

Louis Allis Co., Milwaukee, Wisc.

Cam indexing drive

Catalog shows load ratings, dimensions of no-backlash drives, complete component details.

Ferguson Machine Corp., St. Louis, Mo.

Circle number 34 on reader service card

Continued on next page



Widest Choice of Drive Arrangements and Speed Ratios . . . all V to V

All Gerbing variable speed pulleys utilize the efficient V to V operating principle which allows the use of a V-groove driven sheave. This offers greater effective pulling power, vibrationless transmission of power, and long belt life. HP ratings are from fractional through 25 @ 1750 RPM. Speed is adjusted by a mere turn of the handwheel. Speed-change ratios up to 8 to 1 may be obtained without stopping the motor. Built for years of trouble-free operation. Electric or mechanical remote controls are also available.

ROTO-CONE

- Sizes from 1/a to 25 HP. Speed ratios up to 4 to 1.
- V-belt travels on fixed center line.
 Easily installed.
- Used with stand-ard or counter-shaft adjustable motor bases.

ROTO-DRIVE

- Speed raties up to 8 to 1. No adjustable motor base needed. • Consists of 2 Rote-Cone
- Save up to 40% over conventional drives.
- WAR'A'CONE For all 'A' and 'B' belt drives.
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- Through shaft mounting.
 No interlock-ing discs.
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- Two Var'A'Cones one manually operated.
- Up to 7½ to 1 speed-change ratio.

up to 2% to 1-

- . Fixed shaft centers. No adjustable motor base needed.
- 6 FLEXIBLE COUPLINGS Cushion Type
- 3 Models
 From fractional to 700 HP
 No lubrication
- For details request a copy of Flexible Couplings Bulletin

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- MOTOR BASES complete selection of standard and countershaft adjustable.
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FOR DETAILS REQUEST **BULLETIN AP-158**



Manufacturing Corporation

771 South State Rd., ELGIN, ILL. SH 1-2790

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LITERATURE

continued from preceding page

V-belt drives

Engineering manual shows application of Dickrope "QD" drives with tempered construction increasing hp ratings 40 percent.

R. & J. Dick Co., Inc., Totowa, N. J. Circle number 32 on reader service card

Roller bearing catalog

Catalog PL-559 gives useful data on features, applications, sizes, etc. for 9 lines of roller bearings. Styles included are Air-Rol, precision radial, Tru-Rol, precision thrust, steel cage (both inch and metric), Flexi-Flange, cartridge and traction motor bearings. Special styles also included.

Rollway Bearing Co., Inc., Syracuse, N. Y.

Circle number 46 on reader service card

Armature drive

Spline drive armatures for use with company's electric clutches and brakes for rugged, low-cost drives in high-cycle applications. Bulletin P-68.

Warner Electric Brake & Clutch Co., Beloit, Wisc.

Circle number 27 on reader service card

Couplings

B line has sleeves supported on hubs, positive lubrication, special centering.

Koppers Co., Inc., Baltimore, Md. Circle number 16 on reader service card

V-drive catalog

Extremely detailed product data and engineering information on V-drive parts, including interchangeable bushings, V-pulleys, V-drive accessories, Morgrip belts and special Vlink belting. Catalog F-10, 45 pages, easy-to-follow tables.

Maurey Mfg. Corp., Chicago, Ill. Circle number 47 on reader service card

Clutch line

Bulletin shows typical installations and furnishes capacity tables, dimensions, specifications.

Rockford Clutch Div., Borg-Warner Corp., Rockford, Ill.

Circle number 23 on reader service card

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Variable-speed drives

Roto-Cone and Vara-Cone packages, for fixed and adjustable center distances, fractional to 25 hp and ratios up to 8 to 1. Bulletin AP-158.

Gerbing Mfg. Corp., Elgin, Ill.

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Custom gear line

Metallic and non-metallic gears in virtually all types, wide ranges of pitch and sizes. Booklet shows available line, outlines applications from household appliances to precision instrumentation. Custom-built worm gear reducers also described.

Perkins Machine and Gear Co., West Springfield, Mass.

Circle number 48 on reader service card

Friction and fluid drives

Fluid couplings, air-actuated clutches, friction power take-offs, multiple plate clutches, fluid power take-offs, Hydro-Sheave transmission packages, marine gears, torque converters and other units.

Twin Disc Clutch Co., Racine, Wisc.

Circle number 25 on reader service card

Miniature one-way clutch

Miniclutch is a one-way roller clutch permitting drive in one direction with free-wheeling action in the opposite direction. Fine for automatic cycling, backstopping, selective coupling, etc. Available as roller assembly only, or as complete clutch unit. Catalog C-59, illustrated.

Miniclutch Co., Hamden, Conn.

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Speed reducers

Worm gear reducers in many mountings, ratos from 5:1 to 60:1.

American Stock Gear Div., Perfection Gear Co., Harvey, Ill.

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Continued on page 62

DESIGN CONSIDERATIONS

Backlash in Indexing Mechanisms for High Production Machinery

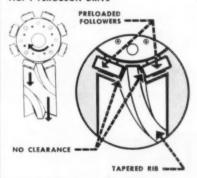
Backlash in indexing results in impact or shock loads that affect the efficiency of a machine and the quality of its product. Most indexing mechanisms have inherent characteristics that cause backlash and poor dynamic conditions and prevent the machine designer from taking full advantage of modern automatic feeds, tooling and methods that contribute so much to production economy.

Of the three principal indexing mechanisms, only one offers zero backlash and years of maintenance-free operation:

FERGUSON DRIVE

Continuously rotating cam includes a tapered rib, along which two preloaded bearing followers roll with no clearance between them and the rib. When the drive is in the rest, or dwell, position a straight portion of the rib locks the followers with zero backlash and an indexing accuracy of .001". Wear of the hardened cam is infinitesimal since it is subject to rolling friction only (many cams have been in use for more than 25 years). Followers are rated for a minimum of 8,000 hours precision operation at speeds up to 2,000 indexes a minute. If followers wear after this time, they can be replaced, thus renewing the drive for a like period.

FIG. 1 FERGUSON DRIVE

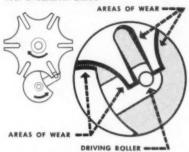


GENEVA DRIVE

A geneva drive consists of a slotted wheel and a driver with a driving roller. Indexing occurs when the roller crashes into the slot, causing the wheel to move one increment. There must be clearance in the slot to allow passage of the roller. With clearance there must also be backlash. Impact loading, resulting from the inherent backlash, causes the slots to wear quickly and the backlash becomes progressively more severe. Operating progressively more severe. Operating seven the dynamic forces generated by backlash, even then, genevas require replacement

with great frequency and downtime for maintenance is a major problem.

FIG. 2 GENEVA DRIVE



RATCHET & CRANK

Tooth clearance backlash causes the pawl to strike the ratchet teeth with considerable impact when indexing begins and vibratory forces are extreme. After mid stroke, the arm stops the pawl gradually but the wheel must be stopped by frictional braking or by positive means. Friction brakes allow over-travel and inaccuracy of index. They wear quickly and require excess downtime for maintenance. Because positive stopping is instantaneous, impact and rebound action of the wheel is tremendous. Neither method of stopping is satisfactory from the standpoint of low maintenance requirements or controlled dynamic conditions. Sustained high speed production is virtually impossible.

FIG. 3 RATCHET & CRANK



. SEND FOR CATALOG

Zero backlash is only one inherent advantage of the Ferguson Drive. Others are explained in an easy-to-use catalog containing load ratings and dimensions of many standard units, drawings and installation photos. There is a copy for every design engineer . . . Write FERGUSON MACHINE CORPORATION, 7818 MAPLEWOOD INDUSTRIAL COURT, ST. LOUIS 17, MO.

For more information Circle No. 34 on Reader Service Card

Motorized wheel delivers more power in less space

By H. J. MCLEAN, motor engineering and H. VITT, control engineering,

Locomotive and Car Equipment Dept., General Electric Co.

ELECTRIC motorized wheels for large off-highway vehicles simplify transmission of traction power. Heavy-duty, traction motor drive eliminates mechanical drive lines, differentials, and torque converters. Four motors deliver full output of the engines up to 1600 hp for traction. The system gives 60% adhesion on all wheels at standstill and full horsepower utilization over most of the speed range to a maximum of 35 mph.

The motorized wheel is designed to conserve both space and weight by placing the motor inside the largely unused area inside the wheel rim. This places parts usually needing most frequent maintenance in a most accessible position—on the outboard end of the wheel rim.

Pole pieces of the series-wound d-c motor are bolted to the inside of the hollow axle. The armature, on a concentric shaft, drives the power gear train through a floating pinion. An airplane-type disc brake is on the commutator end of the shaft.

Wheel bearings are placed around the axle, or magnet frame. They are large diameter tapered roller bearings similar to those used on steel mill rolls. Mounting flange for the motor barrel also forms part of the gear case structure. Armature is splined to a short, 18-tooth, sun pinion whose teeth engage three large 87 tooth planet gears. The planet gears are fixed, that is they do not orbit around the sun pinion but simply rotate on their shafts. Small, 15-tooth, pinions on the planet gear shafts go through openings in the flange wall to drive a 111-tooth ring gear. Ring gear drives the wheel rim through a splined connection.

The gear reduction of approximately 40:1 provides maximum tractive effort of 32,400 lb. This corresponds to 60% adhesion of the 44.5 x 45 tire with 54,000 lb load.

All gears and bearings are splash lubricated by oil except for the motor armature and outer wheel bearings. These are grease lubricated.

Brakes

The motorized wheel has electrical dynamic braking in addition to disc braking. It develops braking effort equal to three times available traction hp and has no



Fig. 1. MOTORIZED WHEEL. Haulage costs using these units are cut to 30% per ton.

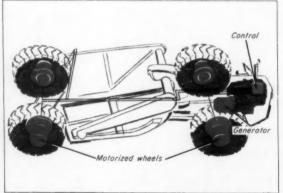
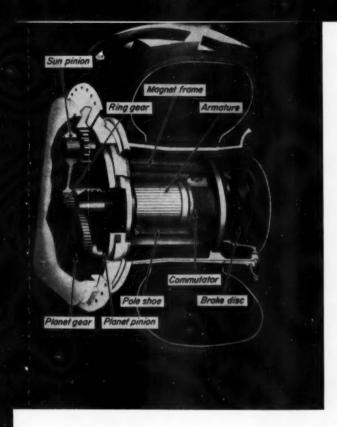


Fig. 2. ELECTRIC DRIVE SYSTEM. Engine-driven generator supplies power to four wheels through cables.



wearing parts. The dynamic system will not act as a holding brake since it exerts no retarding force at standstill, Fig. 4.

Dynamic braking is gotten by reconnecting the motor to act as a generator. Power developed is dissipated in resistors. Force required to drive the motors as generators is taken from the wheel and thus retards it.

The disc brake has a flat, slotted disc splined to the motor shaft. A double-acting hydraulic cylinder bolted to the motor frame clamps the disc with two brake shoes from both sides. Cylinders are actuated either directly or from an air-over-hydraulic source. These brakes will not fade like a drum-type due to expansion. Brake disc is a special alloy designed to operate at 600 F with maximum operating temperature of 1000 F. Maximum kinetic energy capacity is 2,890,000 ft-lb per brake. Raising the disc to normal operating temperature requires 1,735,000 ft-lb; more than enough to bring an 11-ton vehicle to a stop from 30 mph. Torque developed by the brake is 20,000 in.-lb with 590 psi hydraulic pressure.

Motor Arrangements

There are three basic ways to connect the motors on a vehicle using four motorized wheels, Fig. 3. These are: all in series across the generator output; all in parallel across the generator output; two motors in series, in parallel with the other two motors in series.

With the straight series connection, voltage across one motor is ½ total generator voltage. This means that generator voltage would have to be extremely high, with the motors used. Another disadvantage is that if one wheel should slip, its motor would speed up and thus reduce current to the other motors. This is similar to what happens with all wheels driven from a four-wheel differential.

With the parallel connection, each motor gets full generator voltage but total current requirement from the generator would be four times that required by each motor. This means the generator must have extremely high current capacity. An advantage is that a slipping motor would shift its share of the generator power to the other three wheels and they would continue to pull.

Series-parallel connection, a compromise, is the most practical. Voltage and current are half the values required for the other cases. If one wheel slips it affects only the wheel in series with it; the other two still supply full torque. By cross-connecting the motors, Fig. 3d, there is little possibility that the vehicle will stall because of wheel slip.

This article abstracted from a paper presented at the SAE National Farm, Construction, and Industrial Machinery Meeting, Milwaukee Auditorium, Milwaukee, Wis., September 14-17, 1959.

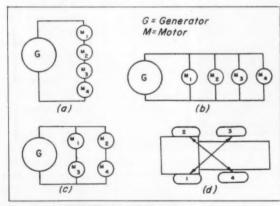


Fig. 3. CONNECTION METHODS for four electric motors driving a vehicle. Series-parallel seems to be best.

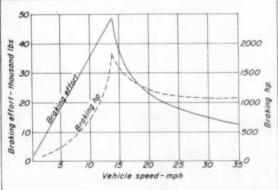
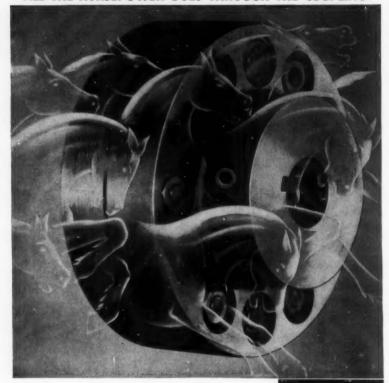


Fig. 4. BRAKING available versus vehicle speed. Note that none is available at zero speed.

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Universal joint

Special brake mounting attaches brake disc or drum to the transmission flange, independent of the bolts that attach the joints to the flange. Unit may be perfectly balanced.

Mechanics Universal Joint Div., Borg-Warner Corp., Rockford, Ill. Circle number 20 on reader service card

Pillow blocks

Designed for extreme precision and high load capacites. Duplex Timken roller bearings with tapered bore. Shaft sizes 13/8 to 8 in. Bulletin A670.

Dodge Mfg. Corp., Mishawaka, Ind. Circle number 33 on reader service card

Clutch pulleys

Variable-speed clutch pulley with a-c motor gives good performance at a fraction of the cost of variable-speed drives. For soft starts, easy acceleration, inching drives. Bulletin M-1.

Horton Mig. Co., Inc., Minneapolis,

Circle number 15 on reader service card

Flexible shafting

Catalog 250 gives details on use of flexible shafting for OEM uses. Standard sizes from 1/4 to 11/4 in. with non-ravel cores.

B. W. Elliott Mfg. Co., Inc., Binghamton, N. Y.

Circle number 10 on reader service card

Spindle design quide

Reference data and application hints on designing and using grease prelubricated ball bearing spindles. Graphs in 8-page bulletin cover all steps, are easy to use.

Fafnir Bearing Co., New Britain,

Circle number 50 on reader service card

Reducer line

Shaft-mounted reducers, in-line helical reducers and gearmotors. Technical bulletin 6-22 gives information on comprehensive line.

Hewitt-Robins, Stamford, Conn.

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Variable-speed sheave

MS motion control sheave won't freeze or stick, eliminates fretting corrosion problems. Bulletin 4101.

T. B. Wood's Sons Co., Chambersburg, Pa.

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Universal joints

Illustrated catalog gives dimensions and suggestions for use of Atlas joints. 15 sizes for all requirements.

Gray & Prior Machine Co., Hartford, Conn.

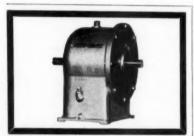
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Gear units

Packaged gear units for right-angle power transfer. Bulletin 592.

Crown Gear Co., Worcester, Mass.

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Automatic clutches

Catalog BL-1 describes complete line of precision-built, standard clutches with MercoTorque action.

Mercury Clutch Div., Automatic Steel Products, Inc., Canton, Ohio.

Circle number 18 on reader service card

Worm gearmotors

Double-enveloping gearmotors. Models include standard shaft or hollow shaft with worm over or under or gearshaft vertical. Catalog 58.

Cone-Drive Gears, Div. of Michigan Tool Co., Detroit, Mich.

Circle number 6 on reader service card

Bronze bearings

2227 sizes cast, sintered, oil-filled stock bearings. Engineering handbook and catalog 58.

Bunting Brass and Bronze Co., Toledo, Ohio.

Circle number 4 on reader service card

Gear packages

Tork-Foot reducers (½ to 400 hp), Rite-Lo-Speed gearmotors (1 to 300 hp), and packaged power terminal with motorized head pulley (1 to 50 hp).

J. D. Christian Engineers, San Francisco, Calif.

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Roller chain

All standard pitches in single and multiple widths for replacement or new equipment. Many special styles described in catalog 51a.

Cullman Wheel Co., Chicago, Ill.

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Angle gears

Selecting 90 degree power takeoff for many applications is simplified by company literature showing design and construction features.

Airborne Accessories Corp., Hill-side, N. J.

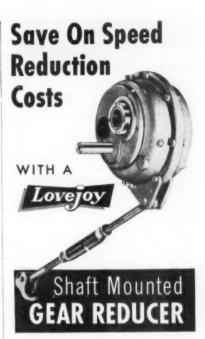
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Speed reducers

Pocket-sized catalog has information on 75 types of reducers, fractional to 400 hp, ratios to 10,000 to 1.

Abart Gear & Machine Co., Chicago, Ill.

Circle number 1 on reader service card



COSTS LESS THAN OTHER SHAFT MOUNTED REDUCERS

- Eliminate supporting structures and shaft couplings required by conventional reducers.
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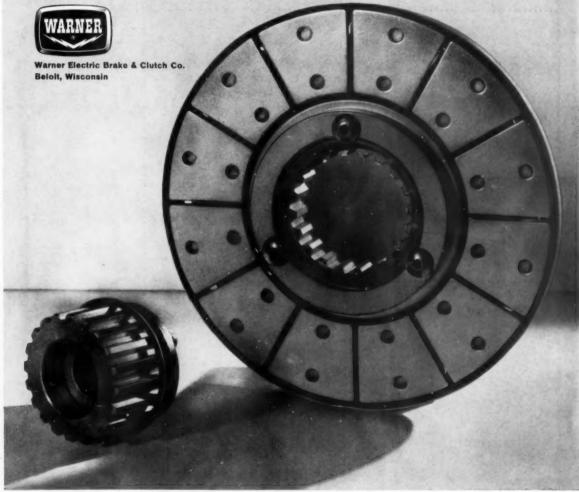
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Spline drive armatures are now available from stock for Models 825 to 1525 Warner electric brakes and clutches. For complete specifications, write for Bulletin P-68.



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